Engineering Library

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The Engineer.

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VOL. CXLVI.—No. 3787] LONDON: FRIDAY EVENING, AUGUST 10, 1928 [PRICE { WITH SUPPLEMENT } ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

HEATING.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Thursday, 30th August, 1928, for ACCELERATED LOW-PRESSURE HOT WATER HEATING at South Shore, Blackpool, Post Office, &c.

Drawings, specification, a copy of the conditions and form of contract, bills of quantities and forms for Tender may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Guinea. (Cheques payable to the Commissioners, H.M. Office of Works.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 9253

HEATING.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Wednesday, 29th August, 1928, for ACCELERATED LOW-PRESSURE HOT WATER HEATING at Hackney, E., Branch Post Office, &c.

Drawings, specification, a copy of the conditions and form of contract, bills of quantities and forms for Tender may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Guinea. (Cheques payable to the Commissioners, H.M. Office of Works.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 9254

The Director-General, India Store Department, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—

SCHEDULE 1.—DOUBLE-LINE LOCK-AND-BLOCK INSTRUMENTS.
SCHEDULE 2.—114 TONS SPRING STEEL.
SCHEDULE 3.—5 LOCOMOTIVE TANK ENGINES, 2-6-4 Type, Metre Gauge.

Tenders due on the 28th August, 1928, for No. 1; on the 31st August, 1928, for No. 2; and on the 4th September, 1928, for No. 3.

Forms of Tender obtainable from the above at a fee (which will not be returned) of 5s. for each Schedule. 9261

War Department. FOR SALE, CAST IRON CIRCULAR TANK, 100ft. diameter, 10ft. 6in. deep, with cast iron bottom, all in segments, situate at Woolwich. Suitable for reservoir or could be made into two circular swimming baths or tanks. Purchasers will be required to dismantle and remove from site.

Further particulars and form of Tender may be obtained and the tank viewed on application to the CHIEF MECHANICAL ENGINEER, Royal Arsenal, Woolwich, S.E. 18. 9255

Assistant Civil Engineers REQUIRED on the permanent pensionable establishment of the Works and Buildings Directorate, Air Ministry. Candidates must be between the ages of twenty-five and thirty years on the 22nd August, 1928; those who have served or are serving in the Army, Navy or Air Force may deduct from their actual age any time, not exceeding five years, during which they have so served. A candidate must be one of the following :—

(i.) A Corporate Member of either the Institution of Civil Engineers, the Royal Institute of British Architects, or the Institution of Municipal and County Engineers;

(ii.) A person qualified to become a Corporate Member of the Institution of Civil Engineers on attaining the prescribed age;

(iii.) A holder of a Degree in Engineering or an equivalent Diploma;

(iv.) A person who has held a commission in the Royal Engineers or an appointment in civil engineering under the British or Indian Government or a Dominion or Colonial Government and has been precluded by such employment from obtaining any of the above qualifications.

He must also have served for two years in an engineering firm of good standing or on the engineering staff of a Government or large municipal department or in the Royal Engineers and have there gained experience in civil engineering both in the drawing-office and on important engineering works. Special consideration will be given to candidates who served in H.M. Forces during the war.

The scale of salary for Assistant Civil Engineers is £250 with annual increments of £15 until the maximum of £450 per annum is reached, plus Civil Service bonus. The commencing salary will be £250 per annum plus Civil Service bonus, which at the current rate amounts to £111 3s. per annum. Successful candidates will be eligible for promotion to the grades of Civil Engineer and Superintending Civil Engineer.

No candidate will be appointed who fails to pass a strict medical examination as to his physical fitness for service at home and abroad.

Successful candidates will serve on probation for two years and their appointments will not be confirmed unless and until they have passed such probation to the satisfaction of the Air Ministry.

Copies of regulations and forms of application can be obtained from the SECRETARY (S.2), Air Ministry, Adastral House, Kingsway, London, W.C. 2; the forms should be returned completed so as to reach that office not later than the 22nd August, 1928.

Candidates must bear any expenses which they may incur in attending for interview. 9205

Applications are Invited by the Government of Bihar and Orissa for the APPOINTMENT of a DRAINAGE ENGINEER, PUBLIC HEALTH DEPARTMENT (Engineering Branch),

to prepare drainage scheme in Patna City.

One year in the first instance with possibility of extension.

Age 30 to 40 years.

Thorough experience of design and execution of works of modern main drainage and sewage purification. Pay in accordance with age scale, rising from Rupees 725 a month at age 30 to Rs. 1175 at age 40, plus, for officers of non-Asiatic domicile, overseas pay £25 a month at age 30 to 33 years and at £30 a month thereafter.

Provident Fund. Free first-class passage to India and back.

Strict medical examination.

Further particulars and forms of application may be obtained upon request by postcard to the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, General Department, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications 25th August, 1928. 9210

The Engineer

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PUBLIC NOTICES

Assistant Engineers (11) REQUIRED by the GOVERNMENT of NIGERIA for the PUBLIC WORKS DEPARTMENT for two tours of not less than 12 nor more than 18 months' service in the first instance. Subject to satisfactory service, the officers appointed will be eligible at the expiration of three years' service for confirmation in the permanent and pensionable establishment. The foregoing officers are required to fill vacancies caused by the increase of the establishment of the Nigeria Public Works Department. Salary £480 a year for the first three years, then £510, rising by annual increments to £920. Outfit allowance of £60 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates must have attained the age of 21½ years on the date of appointment, and should preferably have attained the age of 22½ and must not be over 35 years of age. Must have obtained an Engineering Degree at a recognised University or have passed Sections "A" and "B" of the A.M.I.C.E. Examination or have passed the Associateship in Civil Engineering of the City and Guilds Institute, or possess such other Degree or Diploma or distinction in engineering as may be considered satisfactory. Candidates whose qualifying Diplomas have been obtained without a College course should have had three years' practical experience of Civil Engineering under a qualified Civil Engineer. It is preferred that all candidates should have had two years' practical experience on good engineering work subsequent to taking their degree or completing their articles, but under certain conditions this may be waived in the case of candidates in possession of an Engineering Degree.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, S.W. 1, quoting M/254. 9243

Applications are INVITED by the Government of India for an APPOINTMENT as AIRCRAFT and ENGINE INSPECTOR. Pay, Rupees 1000, rising by annual increments of Rs. 100 to Rs. 1200 a calendar month. Three years' agreement. Provident Fund. First-class passage to India and back. Strict medical examination.

Further particulars and forms of application may be obtained upon request by postcard from the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, General Department, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications 1st September, 1928. 9228

PUBLIC NOTICES

Assistant Engineers (5) REQUIRED by the GOVERNMENT of the GOLD COAST for a tour of 12 to 18 months' service, with possible extension. Salary £480 a year for three years, then £510, rising to £920 a year by annual increments. Outfit allowance of £60 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, aged 25 to 35, must be Corporate Members of the Institution of Civil Engineers or hold an Engineering Degree or Diploma recognised as granting exemption from Sections "A" and "B" of the A.M.I.C.E. examinations or must hold the Testamur of the Institution of Municipal and County Engineers. Must be capable of taking complete charge of construction of buildings, bridges and roads and have a thorough knowledge of surveying, quantities and measuring up of work.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/628. 9176

In the High Court of Justice 1928, R. No. 034
Chancery Division
Mr. Justice Tomlin
In the Matter of REES ROTURBO MANUFACTURING COMPANY LIMITED and REDUCED,
and
In the Matter of THE COMPANIES (CONSOLIDATION) ACT, 1908.

Notice is Hereby Given that the Order of the High Court of Justice (Chancery Division) dated the 25th day of July 1928 confirming the reduction of the capital of the above-named Company from £250,000 (divided into 125,000 Preference Shares of £1 each and 125,000 Ordinary Shares of £1 each) to £112,561 (divided into 81,078 Preference Shares of 10s. each, 43,922 Preference Shares of £1 each, 102,000 Ordinary Shares of 1s. each and 23,000 Ordinary Shares of £1 each) and the Minute (approved by the Court) showing with respect to the capital of the Company as altered the several particulars required by the above Act were registered by the Registrar of Companies on the 8th day of August 1928.

Dated the 9th day of August 1928.
SHARPE, PRITCHARD & CO.,
12, New-court, Carey-street, W.C. 2,
Agents for
UNDERHILL NEVE THORNEYCROFT TAYLOR AND CO.,
Wolverhampton,
Solicitors for the Company.
9262

PUBLIC NOTICES

UNIVERSITY OF LONDON.

King's College.

FACULTY OF ENGINEERING.

COMPLETE COURSES of STUDY are provided in CIVIL, MECHANICAL and ELECTRICAL ENGINEERING for the Engineering Degrees of the University of London and for the Diplomas and Certificate of the College.

POST-GRADUATE COURSES in CIVIL, MECHANICAL, ELECTRICAL and CHEMICAL ENGINEERING are also provided.

HEADS OF DEPARTMENTS :

Professor G. COOK, D.Sc., M.I. Mech. E., A.M. Inst. C.E., Mechanical Engineering (Dean).
S. J. DAVIES, M.Sc., M.I. Mech. E., Reader in Mechanical Engineering.
Professor A. H. JAMESON, M.Sc., M. Inst. C.E., Civil Engineering.
C. H. LOBBAN, D.Sc., A.M. Inst. C.E., Reader in Civil Engineering.
Professor E. WILSON, M. Inst. C.E., M.I.E.E., Electrical Engineering.
F. S. ROBERTSON, M.I.E.E., Senior Lecturer.
Professor S. A. F. WHITE, M.A. } Mathematics.
Professor A. E. JOLLIFFE, M.A. }

Considerable extensions have been made in the Engineering Department. These include a large additional drawing-office, lecture room and laboratory for Hydraulics and Strength of Materials in the Civil and Mechanical Departments, and research rooms, including Wireless Telegraphy, in the Electrical Engineering Department. Large additions have been made to the equipment of the Laboratories in the three Departments for purposes of teaching and research.

There is a College Hostel and a large Athletic Ground.

For full information apply to the SECRETARY, King's College, Strand, W.C. 2. 9119

The Royal Technical College, GLASGOW.

DEPARTMENTS OF ENGINEERING.

MECHANICS AND MECHANICAL ENGINEERING :
Professor ALEXANDER L. MELLANBY, D.Sc., M.I. Mech. E.
Associate Professor WILLIAM KERR, Ph.D., A.R.T.C.
ELECTRICAL ENGINEERING :
Professor STANLEY PARKER SMITH, D.Sc., M.I.E.E., A.M. Inst. C.E.
CIVIL ENGINEERING :
Professor GEORGE MONCUR, B.Sc., M. Inst. C.E., M. Amer. Soc. C.E.
MINING ENGINEERING :
Professor DANIEL BURNS, M. Inst. M.E.
CHEMICAL ENGINEERING :
Professor of Technical Chemistry : THOMAS GRAY, D.Sc., LL.D., Ph.D., F.I.C.

Complete Courses of instruction are provided, qualifying for the Diploma and Associateship of the College and for the Degree of B.Sc. in Engineering of Glasgow University.

Composition fee 25 guineas per annum.

SESSION 1928-29 BEGINS on TUESDAY, SEPTEMBER 25th.

Calendar, by post, 3s., and prospectus, gratis, may be obtained on application to the DIRECTOR. 9007

University of Manchester.

FACULTY OF SCIENCE.

DEPARTMENTS of CIVIL, MECHANICAL and ELECTRICAL ENGINEERING.

COMPLETE COURSES of STUDY, extending over three years, lead to the University Degree in Civil, Mechanical and Electrical Engineering. Students who have shown exceptional ability during the first year are admitted to the Honours Courses. A Prospectus, giving full particulars, may be obtained on application to the REGISTRAR.

The SESSION COMMENCES on THURSDAY, OCTOBER 4th.

DEPARTMENTS.

Professor A. H. GIBSON, D.Sc., M. Inst. C.E., M.I. Mech. E. (Engineering).
Professor ROBERT BEATTIE, D.Sc. (Electrical Engineering).
Professor E. A. MILNE, M.A., M.Sc., F.R.S. (Applied Mathematics).
Professor L. J. MORDELL, B.A., M.Sc., F.R.S. (Pure Mathematics).
Professor ARTHUR LAPWORTH, D.Sc., LL.D., F.R.S. (Chemistry).
Professor W. L. BRAGG, M.A., F.R.S., Nobel Laureate (Physics).
Professor F. C. THOMPSON, B.Sc., D.Met. (Metallurgy).
Professor O. T. JONES, M.A., D.Sc., F.R.S. (Geology). 9232

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PUBLIC NOTICES

University of Bristol.

FACULTY OF ENGINEERING.

(Provided and Maintained in the MERCHANT VENTURERS' TECHNICAL COLLEGE).

VICE-CHANCELLOR: T. LOVEDAY, M.A., LL.D.
DEAN OF THE FACULTY: ANDREW ROBERTSON, D.Sc., M.I. Mech. E., Assoc. M. Inst. C.E.

DEPARTMENTS.

CIVIL ENGINEERING: Prof. A. J. SUTTON PIPPARD, D.Sc., M. Inst. C.E., M.I. Mech. E., F.R.Ae.S.
MECHANICAL ENGINEERING: The DEAN.
ELECTRICAL ENGINEERING: Prof. DAVID ROBERTSON, D.Sc., M.I.E.E.
AUTOMOBILE ENGINEERING: Prof. W. MORGAN, B.Sc., M.I.A.E.
MATHEMATICS: Prof. E. S. BOULTON, M.A., B.Sc.
GEOLOGY: Prof. S. H. REYNOLDS, M.A., Sc.D.
CHEMISTRY: Prof. F. FRANCIS, D.Sc., Ph.D., F.I.C.

Complete Courses of Study extending over three years, leading to the University Degree or Diploma in Civil, Mechanical, Electrical or Automobile Engineering.

A Sandwich Scheme of Training extending over five years may be adopted by selected students.

Full particulars of courses and of the University Halls of Residence may be obtained on application to the REGISTRAR, M.V.T. College, Bristol.

The SESSION 1928-29 COMMENCES on OCTOBER 2nd. 9148

University College of Swansea

(A Constituent College of the University of Wales).

APPLIED SCIENCE DEPARTMENTS.

ENGINEERING.

Professor: FREDERIC BACON, M.A. (Cantab.), A.M. Inst. C.E., M.I. Mech. E., M.I.E.E.
Lecturer in Electrical Engineering: R. G. ISAACS, M.Sc. (Bristol), B.Sc. (Lond.), A.M.I.E.E.
Lecturer in Civil Engineering: A. A. FORDHAM, B.Sc. (Lond.), A.M. Inst. C.E., M.I. Struct. E.
Assistant Lecturer: J. SELWYN CASWELL, A.M.I. Mech. E.

METALLURGY.

Professor: C. A. EDWARDS, D.Sc. (Manchester).
Assistant Professor: L. TAVERNER, A.R.S.M.
Lecturer: L. B. PFEIL, D.Sc. (Lond.), A.R.S.M.
Assistant Lecturers: J. C. JONES, M.Sc. (Wales). R. GRIFFITHS, B.Sc. (Wales).

The College offers a number of exceptional advantages to Students who aim at entering upon professional careers in Engineering or in Metallurgy. It is situated in the heart of an industrial area, which includes a large number of works of very varied character, and presents an unrivalled variety of metallurgical practice. The manufacturers of the district, who contribute largely to the support of the College, give the staff and Students of the Applied Science Departments every access to the works, and the Managers, Engineers, and Technical Officials co-operate with the Staff of the College in making visits to works of practical educational value to the Students.

Courses of study are provided (1) for the B.Sc. Degree of the University of Wales in (a) Civil Engineering, (b) Mechanical Engineering, (c) Electrical Engineering, (d) Metallurgy; and (2) for Diplomas of the College in (a) Civil Engineering, (b) Mechanical Engineering, (c) Electrical Engineering, (d) Metallurgy.

Persons who are not desirous of studying for Degrees or Diplomas may attend selected College Classes, provided they satisfy the authorities of the College that they are qualified to benefit by such Classes.

Entrance Scholarships will be offered for competition in September, 1928.

Particulars concerning admission to the College, and of the Entrance Scholarships, may be obtained from the undersigned.

EDWIN DREW,
Registrar.
Singleton Park, Swansea. 8995

Parish of St. Mary, Islington.

LAUNDRY MACHINERY AND ALTERATIONS IN LAUNDRY.

The Guardians of the Poor of the Parish of St. Mary, Islington, invite TENDERS (a) for SUPPLYING and FIXING certain new MACHINERY in the Laundry at their Infirmary, Highgate-hill, London, N.; (b) for the PURCHASE, including removal, of certain old MACHINERY and APPARATUS; and (c) for REMOVING and RE-FIXING other existing MACHINERY and APPARATUS.

Official forms of Tender, which alone will be received, can be obtained from the Clerk to the Guardians personally at the undermentioned address or a stamped addressed brief size envelope may be sent.

The Laundry can be inspected and further particulars obtained on application at the Steward's Office at the Infirmary, on any week-day, excepting Saturday, between the hours of 10 a.m. and 12 Noon, or 2 and 4 p.m.

Sealed Tenders must be delivered at the undermentioned offices not later than 3 p.m. on Thursday, the 23rd day of August, 1928, and they will be opened at a meeting of the Guardians on that day.

The Guardians do not bind themselves to accept the lowest or any Tender.

By Order,
ALBERT KING,
Clerk to the Guardians.

Guardians' Offices,
St. John's-road,
Upper Holloway, N. 19,
1st August, 1928. 9235

River Wear Commissioners.

No. 23 COAL STAITH QUAY.

The River Wear Commissioners are prepared to receive TENDERS for the CONSTRUCTION of a QUAY WALL and Contingent Works upon land in and adjoining the Hudson Dock South, Sunderland.

The conditions of contract, forms of Tender, specification, schedules of quantities and drawings may be seen at the offices of the Commissioners upon application to the undersigned before the 8th day of September, 1928, or may be obtained until that date on payment of the sum of Ten Pounds (£10) by crossed cheque, which will be returned on receipt of a bona fide Tender accompanied by the whole of the documents.

Tenders, which will only be accepted on the forms supplied, must be completed in accordance with the detailed instructions incorporated in the documents, enclosed in a cover, sealed and endorsed "Tender for No. 23 Coal Staith Quay," and delivered to the undersigned at the Commissioners' Offices, Sunderland, not later than 10 a.m. on the 10th day of September, 1928.

The River Wear Commissioners reserve the right to reject a Tender without assigning a reason, and do not bind themselves to accept the lowest or any Tender.

F. HUMBLE,
Clerk to the Commissioners.

Harbour and Dock Offices,
St. Thomas-street, Sunderland,
1st August, 1928. 9233

The Burma Railways Company, LIMITED.

The Board of Directors of the Burma Railway Company, Ltd., are prepared to receive TENDERS for the SUPPLY of—

507.6 Tons of STRUCTURAL STEELWORK in PLATE GIRDER SPANS.

For each copy of the specification a fee of £2 will be charged, which fee is not returnable. Tenders, enclosed in sealed envelopes, addressed to the Chairman and Directors and endorsed "Tenders for Structural Steelwork in Plate Girder Spans," must be delivered at this Company's office not later than 12 Noon on Monday, the 17th September, 1928.

The Directors do not bind themselves to accept any or the lowest Tender.

By Order of the Board,
R. G. McGECHIE,
Secretary.

199, Gresham House,
Old Broad-street, London, E.C. 2,
7th August, 1928. 9240

PUBLIC NOTICES

Bombay, Baroda and Central INDIA RAILWAY COMPANY.

The Directors are prepared to receive up to Noon on Friday, 24th August, TENDERS for the SUPPLY of—

1. STEEL SLEEPERS.
2. STEEL SLEEPER KEYS.

Tenders must be made on forms, copies of which, with specification, can be obtained at these Offices on payment of 20s. each for No. 1 and 10s. each for No. 2 (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG,
Secretary.

Offices, The White Mansion,
91, Petty France, Westminster, S.W. 1,
3rd August, 1928. 9226

State Electricity Commission OF VICTORIA, AUSTRALIA,

22-32, WILLIAM-STREET, MELBOURNE, AUSTRALIA.

TENDERS are hereby INVITED for the MANUFACTURE, TESTING, SUPPLY, DELIVERY, ERECTION COMPLETE, and MAINTENANCE of MECHANICAL STEP GRATES and ACCESSORIES, for the Yallourn Power Station, in accordance with Specification No. 28/48.

Copies of Tender form, specification, drawings, &c., will be available upon application to the Agent-General for Victoria, Victoria House, The Strand, London, England.

Charge £1 1s. for three copies of Tender form, conditions of tendering, specification, contract conditions and drawings complete. This charge is returnable under certain conditions as specified in the general conditions of tendering.

Extra copies 10s. 6d. each, not returnable. A preliminary deposit of £50 shall be lodged with Tender.

Tenders, on prescribed form, properly endorsed and addressed, must be delivered to the undersigned in Melbourne not later than 12th November, 1928.

The Commission does not bind itself to accept the lowest or any Tender.

W. J. PRICE,
9224 Acting Secretary.

Cheshire County Council.

MAIN ROADS AND BRIDGES DEPT.

The Cheshire County Council REQUIRE the SERVICES of a RESIDENT ENGINEER to Superintend Construction of Reinforced Concrete Bridge and about 2½ Miles of Main Road Reconstruction. Must have had responsible charge of similar works. The person appointed will be required to enter into an agreement and the appointment will be temporary only, and, subject to satisfactory service, will be for a period of about two years. Salary £600 per annum.

Applications, together with particulars of previous experience and copies of three recent testimonials, to be addressed to the undersigned in sealed envelopes, marked "Resident Engineer," and received not later than Monday, 20th August, 1928.

G. E. ASHWORTH, M. Inst. C.E.,
County Surveyor and Bridgemaster.

County Surveyor's Office,
The Castle, Chester,
1st August, 1928. 9208

County Borough of Wolverhampton.

WATER DEPARTMENT.

JUNIOR ENGINEERING ASSISTANT.

APPLICATIONS are INVITED for the POST of JUNIOR ENGINEERING ASSISTANT in the Water Department, at a salary of £200 per annum, subject to percentage deductions in accordance with the Local Government and other Officers Superannuation Act, 1922. The selected candidate will be required to pass a medical examination.

Applications, stating age, qualifications and experience, together with copies of three testimonials, must be delivered to the undersigned on or before 20th August, 1928. Envelopes are to be endorsed "Junior Engineering Assistant."

F. E. WARBRECK HOWELL,
Town Clerk.

Town Hall, Wolverhampton,
3rd August, 1928. 9173

Electrician Fitter Wanted

IMMEDIATELY for Engineering Maintenance Work at the SURREY COUNTY SANATORIUM, Milford, Surrey. Applicants must give proof of technical knowledge in steam and electrical departments, and have experience in boilers, pumps, D.C. generators, switchboard and refrigerators. Salary at the rate of £160 p.a., together with (a) house (rent and rates free) and water supply, or (b) lodging and washing. Age preferably not to exceed 35.

The appointment is subject to the provisions of the Local Government and other Officers Superannuation Act, 1922, and to the Standing Orders of the Council.

Applications, stating age, qualifications and experience, together with copies of recent testimonials, should be made on the prescribed form and sent to the Medical Superintendent, Surrey County Sanatorium, Milford, Surrey, from whom copies of the application form may be obtained and to whom all enquiries relating to the appointment should be addressed.

DUDLEY AUKLAND,
Clerk of the County Council.

County Hall, Kingston-on-Thames,
31st July, 1928. 9200

Metropolitan Borough of GREENWICH.

APPOINTMENT OF ASSISTANT BOROUGH ENGINEER AND SURVEYOR.

The Council of the Metropolitan Borough of Greenwich is prepared to receive APPLICATIONS for the APPOINTMENT of an ASSISTANT BOROUGH ENGINEER and SURVEYOR at an inclusive salary at the rate of £550 per annum, less superannuation contributions.

Applicants must be Members or Associate Members of the Institution of Civil Engineers and the gentleman appointed should have had municipal experience and must devote the whole of his time to the service of the Council.

Applications, in the handwriting of the applicants and on forms to be obtained from the undersigned, must be accompanied by copies of not more than three recent testimonials, and delivered here not later than Twelve Noon on Friday, the 24th August, 1928, sealed and endorsed "Assistant Borough Engineer and Surveyor."

The appointment will be terminable by one month's notice on either side, and will be subject to the provisions of the Council's Superannuation Act.

Canvassing members of the Council, either directly or indirectly, will be a disqualification.

Stamped addressed foolscap envelope must accompany application for form.

FREDERICK J. SIMPSON,
Town Clerk.

Town Hall, Greenwich, S.E. 10,
18th July, 1928. 9118

Perak River Hydro-Electric POWER COMPANY, LIMITED.

APPLICATIONS are INVITED (by letter only) from properly qualified candidates for IMMEDIATE APPOINTMENT in Malaya as

INSPECTORS FOR REINFORCED CONCRETE WORK.

Applicants must be experienced Clerks of Works, thoroughly conversant with general work connected with civil engineering, especially reinforced concrete and preliminary earth work. Salary £450 to £550.

Selected candidates for these posts will only be appointed subject to passing a strict medical examination.

Agreement for about 1½ years, free second-class passage to Malaya, and home again on satisfactory termination of service.

Applicants must forward details of career, giving particulars of education (general and technical), practical training, and subsequent experience, with names of employers, appointments held, and dates of such employment, together with COPIES ONLY of testimonials, &c., to the undersigned as soon as possible, but in any case not later than August 20th, 1928. Applications will be considered as received.

RENDEL, PALMER & TRITTON,
Appointments Dept.,
9257 13, Dartmouth-street, Westminster, S.W. 1.

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, CHIEF ENGINEER-MANAGER, to Take Control of Gear Works; must be first-class man, thoroughly competent and conversant with Design, Material Buying, Estimating and Manufacture of Modern Gearing, with, in addition, a good commercial knowledge of the Gear Trade. Will be required personally to estimate for, and, if necessary, negotiate orders.
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For continuation of Small Advertisements see page 4.

A Seven-Day Journal

Banks and the Belgian Steel Industry.

ATTENTION is drawn in *L'Usine Belge* to the growing concentration of the Belgian iron and steel industry and to its control by the banking interests. Although only two banks, namely, the Société Générale de Belgique and the Banque de Bruxelles are chiefly concerned, both of them are extremely powerful institutions. The stock exchange value of the Société Générale is about 6,000,000,000 francs, or, say, £34,000,000, that of the Banque de Bruxelles being about half this sum. Both banks, apparently in a spirit of rivalry, have been absorbing other banks in the kingdom, and otherwise showing great activity, their interests in industry increasing daily. The Société Générale holds complete control of the Société D'Athus-Angleur, with its thirteen blast-furnaces, and of the Société de la Sambre et Moselle-Châtelineau with seven blast-furnaces, each of these companies being formed by a fusion of others as indicated by their names. Furthermore, including the holdings of the Banque D'Outre-Mer, recently absorbed by the Société Générale, the latter bank held on December 31st last 10,000 shares in the Usines de la Providence, 10,000 shares in John Cockerill, 2500 in the Ougrée-Marihaye Steel Company, and 14,000 in the Hadir Company of Luxemburg. It is believed that the holdings in these companies are considerably larger to-day, especially as regards the first two mentioned, which have no special means of protecting themselves against outside control. The Ougrée-Marihaye Company took steps against such an eventuality a long time ago by a system of plural voting, designed to keep the power in the hands of its directors. As regards the Hadir Company, it is known that 52 per cent. is held by the French group of La Marine and Homécourt. Again, the Société Générale has just acquired in Germany, where the combination was recently carried out, 34,000 shares in the United Steel Works of Burbach-Eich-Dudelange, or the so-called Arbed Company of Luxemburg. At the price of 14,000 francs this represents about £2,850,000. There are altogether 250,000 shares, of which a large number are held by the Schneider-Union-Européenne group. It is also said that the Société Générale is interesting itself at the present time in the Thy-le-Cateau Steel Works. As to the Banque de Bruxelles, except for 10,000 shares in the Arbed Company, and 3000 in the Thy-le-Cateau Company, this bank is not interested either so directly nor so strongly as the Société Générale in the companies which it patronises. Nevertheless, it has directors on the boards of the Société d'Espérance, the Longdoz Company, John Cockerill, and the Forges de Clabecq, but its primary concern would seem to be to secure itself against the enterprise of the Société Générale.

An Interesting Launch.

A LAUNCHING ceremony of an unusually interesting character took place at the Queen's Island Yard of Harland and Wolff, Ltd., Belfast, last week, when a new fore end for the Royal Mail motor vessel "Lochmonar" was safely put into the water. The new bow portion is 175ft. in length and was launched complete with the deck erections, winches, and deck fittings, and with projecting plates at the after end ready for riveting to the main part of the ship. It will be recalled that the "Lochmonar" ran ashore on the Mersey Revetment in December of last year, and was so badly damaged that it was necessary to cut off about 150ft. from the ship and to construct a temporary bulkhead just forward of the captain's bridge, which allowed the vessel to be towed to Belfast. The two parts of the "Lochmonar" are now dry-docked and will be joined together. At the Spring Meetings of the Institution of Naval Architects, Professor E. G. Coker gave a paper, inspired by the mishap to the "Lochmonar," on "Stresses in the Hulls of Stranded Vessels," in which by his photo-elastic method of investigating stress distribution, he calculated the stress to which the hull of a ship might be subjected at points of discontinuity in section. The "Lochmonar" is a 485ft. motor vessel of about 9400 gross tons, propelled by twin-screw, eight-cylinder, Harland-B. & W., single-acting, four-cycle oil engines of 4500 total S.H.P., and she was completed in 1924. Up to her stranding she had given excellent service in her owner's fleet.

Chaining the Dome of St. Paul's.

IN the scheme for the preservation of St. Paul's Cathedral, drawn up by a committee of engineers and others, and now rapidly nearing its practical fulfillment, the principal feature to attract attention was the re-conditioning of the eight piers supporting the dome by pumping liquid cement mortar into their rubble-filled interiors. Even with perfectly solid and thoroughly stable piers, however, all anxiety as to the future of Wren's masterpiece would not be removed. The dome itself is not truly concentric on the piers, and with the passage of time—largely as a result of seasonal variations of temperature—the dome, if nothing is done to stop it, will continue to spread and to increase the excentricity of loading on the piers. To meet this condition, the committee recommended that the dome—or, more precisely, the drum interposed between the tops of the piers and the actual dome—should be encircled with metallic banding. That banding has within the past week or so been completed and brought to the Cathedral ready for application. It consists of a stainless steel chain made by Brown, Bayley's Steel Works, Ltd., at Sheffield. This chain is composed of thirty links, of which fifteen consist each of four bars—two at 3½in. square and two at 1$\frac{13}{16}$in. by 3½in.—and fifteen each of which consists of three bars, 3½in. square. The links are articulated by means of pins, 3½in. in diameter, inserted through the swelled up ends of the rods, and held in position by cotter pins. The chain has a total length of about 450ft., and weighs just under 30 tons. The material of which it is composed has an ultimate strength of 45 to 50 tons per square inch, and by means of wedges will, after it is placed in position, be stressed to a total load of 1000 tons. The working stress in the bars composing the links will then be about 30 tons per square inch.

A Thomas Telford Memorial.

ON Friday of last week, August 3rd, the Duke of Buccleuch unveiled in the Parish of Westerkirk, near Langholm, in Dumfriesshire, a granite memorial which has been erected to Thomas Telford, the First President of the Institution of Civil Engineers, and which fittingly commands a view of the valley where Telford was born and where he spent his earlier years. The memorial, which takes the form of a pair of seats on a platform a foot above the roadway, overlooks the confluence of the rivers Meggat and Esk, and the project was carried out jointly by the Eskdale and Liddesdale Archæological Society and the Institution of Civil Engineers. It is executed in grey granite from the Creetown quarries, and the greater part is left rough, only the seats, platform and steps being dressed. The central column at the back of the 13ft. wide and 6ft. deep platform upon which the two seats are mounted stands about 6ft. high, and near the top is a panel containing a bronze medallion of Thomas Telford in bas-relief, with the following inscription on a bronze panel below it: "Thomas Telford, F.R.S., born August 9th, 1757, President Institution of Civil Engineers from March 31st, 1820, until the time of his death, September 2nd, 1834." Engraved on the stone below is the mark which was used by Telford when working as a mason. At the base of the column the following inscription is cut in the granite: "Erected in the Centenary Year (1928) of its Grant of a Royal Charter by the Institution of Civil Engineers in conjunction with the Eskdale and Liddesdale Archæological Society." Other inscriptions refer to Telford's apprenticeship to a stonemason in Langholm, his fame as an engineer, and his untiring benevolence. The monument is of massive proportions, and weighs from 7 tons to 8 tons. It was erected by Messrs. Beattie and Co., of Carlisle.

The Tame Basin Drainage Scheme.

AT a meeting of representatives of local authorities held at Birmingham on Friday of last week, August 3rd, a report on the proposed regional drainage scheme for the towns and districts in the upper basin of the river Tame was considered. It had been prepared by Mr. Herbert H. Humphries, the City Engineer and Surveyor of Birmingham, with the object of dealing economically and efficiently with the drainage and sewage disposal problems in the area under review. A deep level valley sewer is proposed, which would have a length of about 14 miles from the works of the Birmingham Tame and Rea District Drainage Board to the sewage disposal works of the Oldbury District Council. With this new sewer it would be possible to eliminate all the existing sewer syphons, pumping stations and disposal works, both chief and subsidiary. The assumed discharge is based on a daily dry-weather flow of sewage of 30 gallons per head of a population one and a-half times that of 1926. It is estimated at about 4711 cubic feet per minute over a period of twelve hours, but the ultimate quantity of sewage and storm water to be allowed for amounts to about 17,516 cubic feet per minute or 29,214 cubic feet per minute if certain areas in the City of Birmingham are taken into account. The total cost of making the new sewer is estimated at £1,199,700, in addition to which there would be the cost of the treatment of the sewage. The report was considered at length, and it was decided by the meeting to consult the various councils interested, and to hold another conference after the vacation for a further discussion of the scheme.

The Telephone Service.

FIGURES recently collected by the General Post Office to illustrate the development of the telephone service within recent years show that during the year ending last March there was an increase of 122,405 telephones, which was a record for this country. The total number in use was 1,631,191. Great Britain has still a long way to go, however, before it can claim to be on an equality with its competitors. The United States leads the world with 18,500,000 telephones, Germany has 2,800,000 and Canada 1,200,000. During the past three years the rate of increase in the United States has been 15 per cent., in Germany and Canada 18 per cent., and in Great Britain 28 per cent. The total number of call offices now open in this country is 24,054, of which 5244 are in London and 18,810 in the provinces. The receipts from the call offices last year amounted to £953,428, an increase of £61,710, or 6·9 per cent. During the past three years one of the most striking developments has been the increased use of the telephone for international communications. Whereas three years ago the only place to which subscribers could telephone outside this country was Paris, there are now through lines to France, Belgium Holland, Switzerland, Sweden, Spain, including Gibraltar, and Portugal. By means of switches it is possible to reach Austria and Hungary, through Frankfort, Czechoslovakia and Danzig through Berlin, and Luxemburg through Brussels. The Transatlantic telephone service already covers the operating costs and depreciation charges on that part of the Rugby station which is used for the service. The highest number of calls in one week was reached early in May, when the figure rose to 317. Since that date the traffic has diminished and a fortnight ago there were only 107 calls in a week, owing, it appears, to seasonal slackness on both sides of the Atlantic. The extent to which cables are being used for telephonic communication is indicated by the fact that during the past three years no less than £10,000,000 have been spent on underground work.

Railwaymen's Wages.

THE provisional agreement arrived at between the railway companies and the representatives of the three railway unions under which there is to be a 2½ per cent. all-round reduction in wages, salaries and fees has been the subject of discussion among the unions themselves during the past week. A notable lead to the other unions was provided at a National Delegate Conference of the Associated Society of Locomotive Engineers and Firemen, held on Wednesday, August 8th. By a majority, believed to be small although effective, it was decided to accept the proposed agreement. The endorsement of the agreement by the National Union of Railwaymen and the Railway Clerk's Association remains to be secured. Meanwhile a certain amount of difficulty has arisen in connection with the application of the reduction to the railway shopmen. The total number of shopmen employed by the railways is about 120,000. Some of them are members of the National Union of Railwaymen, but others belong to the Amalgamated Engineering Union or the Federation of Engineering and Shipbuilding Trades. These two craft unions were not parties to the discussions which resulted in the provisional agreement, and apparently resent the application to their members of an agreement negotiated by the executives of other unions. A meeting between the companies and the representatives of the craft unions was held in London on Thursday of last week, August 2nd, but, after a three hours' discussion, it was adjourned until to-day, Friday, in order to give the unions' representatives time to obtain authority to accept or reject the proposals.

A German Shipyard to Close Down.

IT is reported from Berlin that the shipyard and engine works of the J. C. Tecklenborg Company, of Wesermünde-G., on the Weser, near Bremerhaven, is to be closed down and the plant disposed of. It will be recalled that the Tecklenborg undertaking is one of the associated companies forming the Deutsche Schiff und Machinenbau A.G. of Hamburg and Bremen, which undertaking also includes the Weser yards and the Vulkan works at Hamburg. If the report is true it can only be looked upon as a measure of concentration and economy, which has been decided upon following the principle of rationalisation, which is now going on in the German shipbuilding industry. The firm of Tecklenborg is one of the oldest in Germany, and it was founded in 1840. Before the war many notable ships were built at the yard, and the firm was well known, both for its marine, steam and oil engines. During the war period the yard was mainly employed in the building of auxiliary craft for the German Navy. It has five building berths, two of which are over 700ft. in length, besides which there are three slipways and five graving docks. When working at its full capacity about 3000 men used to be employed, and the engine works were considered to be among the best equipped in Germany.

Italian Submarine Disaster.

WE regret to have to record the loss of the Italian submarine "F 14," which was rammed by the Italian destroyer "Missori" on the morning of Monday, August 6th, and sunk in about 15 fathoms of water at a point 7 miles west of the Brioni Islands, near Pola. Owing to stormy weather, it was not possible to carry out immediate salvage operations, but on Monday night the wreck was located, and on Tuesday evening it was brought to the surface. Up to Tuesday morning signals from the imprisoned men were heard, and hopes were entertained of rescuing them, tubes for the conveyance of oxygen being attached to the hull during the lifting operations. When the boat was raised to the surface, it was found, however, that the whole of the crew had been asphyxiated by chlorine gas or had been drowned.

Some Recent Canadian Hydro-Electric Power Plants.

One of the leading features of industrial development in Canada during recent years has been the very large number of hydro-electric power plants that have been constructed. Great as has already been the progress in this direction, it is certain to be very considerably increased in the future. At the present moment numerous stations are under construction or extension, and many others are in the preliminary stages or in contemplation. From time to time we have given illustrated descriptions of several of the leading plants, and in the following article we are able to place before our readers particulars of three further stations, all of which have features of more than usual interest.

Chelsea Falls Station on the Gatineau River.

The Chelsea Falls power plant—two views of which are given in our Supplement—which is the second largest of a series of hydro-electric developments being constructed by the Gatineau Power Company on the Gatineau River, in the Province of Quebec, is practically completed, and is now delivering power to industries in the district. Provision has been made in this plant for four 60-cycle units, two of which are installed, and one 25-cycle unit is also operating.

Chelsea Falls, situated about 7 miles north of the city of Ottawa, is a naturally ideal power site, the Gatineau River at that point being divided into two channels. On the west channel is the power-house, and on the east are the sluices and the spillway. The elevation at the top of the spillway is 315ft. above sea level and the tail-race elevation is 222ft., giving an effective operating head of 93ft. The crest level of 315ft. at the Chelsea barrage creates a lake about 12 miles long and averaging about 1½ miles wide. In creating this lake it was necessary to move to higher ground 5 miles of railway line, and to lay out and build about the same length of roadway in place of the former provincial highway that was under water when the sluice gates were closed.

The barrage is about 1600ft. long and has five regulating sluice gates. On account of their size, the method of their operation is unusual. For each of the gates two pairs of hoisting screws are used instead of the usual method of two per gate. Each pair of screws is mounted on a travelling hoisting carriage, which may be quickly moved from one gate to the other. The operation in the winter time of large gates like these has been somewhat of a problem to power companies, and, in order to overcome any difficulties due to freezing in of the gates, provision was made in the concrete structure for electric heaters. They are placed close to the gate guides, and extend down from the surface a distance of approximately 12ft. The downstream face of the gates and the outside of the stiffening "I" beams have been covered with wooden sheeting, which provides space where electric heaters can be installed. These heaters, together with those near the gate guides, are sufficient to keep the gates free from ice during the coldest weather. The operating screw hoists are all motor driven, and are controlled through the station service.

The Chelsea power-house is a compact station housing intake racks, gates, transformers and circuit breakers for five units. The units in this plant are spaced 48ft. centre to centre—see Fig. 1. The equipment is divided into two parts: That housing the generators and turbines and that housing the transformers, circuit breakers, 110-kV buses, control-room, gate-house, and the usual offices. There are normally five floors, each being served from an Otis-Fensom elevator which is arranged approximately in the centre of the station in line with the pump pit between units three and four. These floors are:—Generator-room floor; transformer floor; conduit tunnel; transformer oil circuit breaker rooms; control-room; and bus switching rooms. At one end of the building, beyond the 110-kV buses, there is another floor where the offices are situated. Practically all the electrical equipment in the station and in the outdoor switching structure was supplied by the Canadian Westinghouse Company, excepting the pumping equipment in the pump pit.

The Generating Units.—All the turbines were supplied and installed by the Dominion Engineering Works. They are of the Francis vertical shaft type, with concrete spiral scroll cases, and hydro cone draught tubes. They are designed for a minimum head of 88ft., a normal head of 93ft., a maximum head of 100ft., and a speed of 100 r.p.m., and the guaranteed efficiency at full load is 90 per cent.

The water inlet to each turbine is subdivided into three rectangular openings, which are provided with separately-controlled concrete-loaded gravity type gates. These three unit gates, 13ft. by 22ft., are common to a motor-driven shaft, the connections being made through cable drum hoists. The turbine gates are the inside type, outside-lubricated, and are controlled through water-actuated servo-motors by a new type of Woodward governor. The units are provided with Kingsbury thrust bearings and adjustable lignum vitæ guide bearings of the type usual for large vertical units.

The rating of the 60-cycle generators is 36,000 kVA at 80 per cent. power factor, 6600 volts, three-phase, 100 r.p.m. Each generator has its own direct-connected exciter. The rating of the 25-cycle generator is 32,000 kVA at 90 per cent. power factor, 6600 volts, three-phase, 100 r.p.m.

The Chelsea station will be connected with the Paugan station, further up the river, by a steel tower, two-circuit, 110-kV line, over which the 25-cycle power from the above generator will be taken, and it will operate in parallel with the Paugan units.

As the 25-cycle units in the Gatineau plants will be part of an inter-connected system designed to cover a large territory, because the hydro-electric plants are a long distance from the load to be supplied, and also on account of there being three generating systems, the quick-response excitation for these units was adopted. The method of excitation of the units may be briefly described as follows:—

There is an auxiliary 550-volt alternator built in the frame of the main unit, which is excited by the direct-connected exciter. This auxiliary generator drives a separate motor generator set, the generator of which is the exciter for the main 25-cycle generator. The speed of the motor generator set is approximately 725 r.p.m. This is a comparatively high speed. Therefore, having a comparatively small amount of active material, and there being two or more distinct parallel paths in the field to reduce the inductance, the conditions make for quick response excitation, and, therefore, stability in the transmission system.

Water Wheel Governors.—The turbine governors are of a new pattern, designed and supplied by the Woodward Governor Company. They are neat and compact, and are of the fly-ball type, driven by a small motor in the head of the governor mechanism. The water used in the servo-motors actuating the turbine gates is drawn from the forebay, then treated and passed through a filter before being used for the governor operation.

At the west end of the station a spur line of standard gauge enters the building at generator floor level, and runs through the full depth of the building, terminating in a well under the gatehouse. The utilisation of this well allows materials to be hoisted to the gatehouse floor by means of the forebay crane, which is common to the emergency gates, racks and head gates.

In the pump pit, which comes between units two and three, are the cooling water pumps, governor pressure pump, oil pumps, service air compressor pump and tail water graphic recorder. The latter, like the forebay water recorder, which is in the gate-house, is equipped with reflector heaters that direct heat on to the top of the floats, to prevent ice from forming.

The generator-room, with its cream-coloured walls, red-tiled floor, battleship-gray machines, presents an appearance of ultra-efficiency, which is further supported by the traffic signal system installed on the south wall by which, together with a klaxon horn, the operator may signal the floor man to raise, lower, or stand-by any unit, or receive verbal instructions by telephone. Each generator platform is connected at the same level with the gallery which runs the length of the north wall. From this gallery fire-proof doors lead to the transformer track runway and transformer cubicles. The cubicles are separated by fire-proof walls and the track is partitioned off at the wall by steel shutters.

Each unit has its own transformer bank and a cubicle for potential transformers is arranged between power banks. The 60-cycle power transformers are rated at 11,000 kVA, each 6600/110,000 volts, single-phase, o.i.w.c. The 25-cycle transformers are rated at 11,000 kVA, 6600/110,000 volts, single-phase, o.i.w.c. The generator and transformer are equipped with differential relay protection. The 110-kV secondaries of the power transformers are taken to

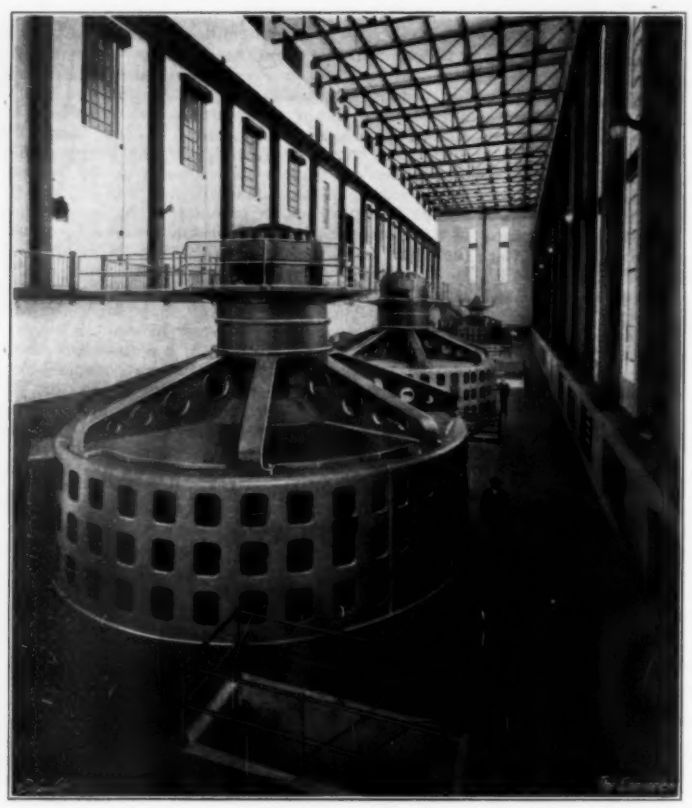


Fig. 1—Generator Room—Chelsea Falls Station

Fig. 2—Oil Circuit Breakers—Chelsea Falls Station

the transformer oil circuit breakers on the floor above through floor bushings. Each 110-kV circuit breaker is in a separate room isolated from the other equipment by fireproof walls.

The disconnecting switches inside the station are a new type of gang-operated switch for 110-kV service, and were supplied and installed by the Canadian Westinghouse Company. The operating rods pass through the fireproof wall to the motor-operated mechanism, which is remote controlled from the main switchboard. On this floor there is also the battery-room, which contains a 250-volt battery of Exide cells operating in parallel with a motor generator set on the generator-room floor. The main control room is on the same floor as the battery room, and overlooks the lower roof of the building. From this point also a clear view of the stream between Chelsea and Farmers is obtained.

Station Service.—For the operation of auxiliary equipment there is on the transformer floor a 1000-kVA, three-phase, 110,000/550-volt transformer, which supplies all the 550-volt station service feeding the auxiliary equipment through oil circuit breakers. Here also there are 550/220-volt lighting and heating transformers. Normally, the generators supply sufficient heat for the building, but the offices and control-room are equipped with wall type electric heaters.

A noteworthy feature of the station service is that the 550-volt bus is tied in with the Farmers 550-volt station service, one mile downstream, through the necessary oil circuit breakers, so that in the event of a complete shut-down in either plant, the auxiliaries will still be in service, and the water-wheel governor pressure maintained.

The outdoor switching structure controls the duplicate outdoor bus-bars. Normally, the 60-cycle units feed the indoor and outdoor buses. The 25-cycle unit runs straight to the duplicate 25-cycle outdoor buses, there being no indoor 25-cycle buses. In the case of emergency, the outdoor buses can all be tied together by the usual arrangement of bus tie oil circuit breakers and disconnecting switches.

The oil circuit breakers controlling the various circuits running out from the indoor structure were supplied and installed by the Canadian Westinghouse Company. The relays controlling the operation of the circuit breakers are all housed in a relay house close to the switching structure. This building is equipped with electric heaters.

FIG. 3—GENERATOR ROOM—GREAT FALLS STATION

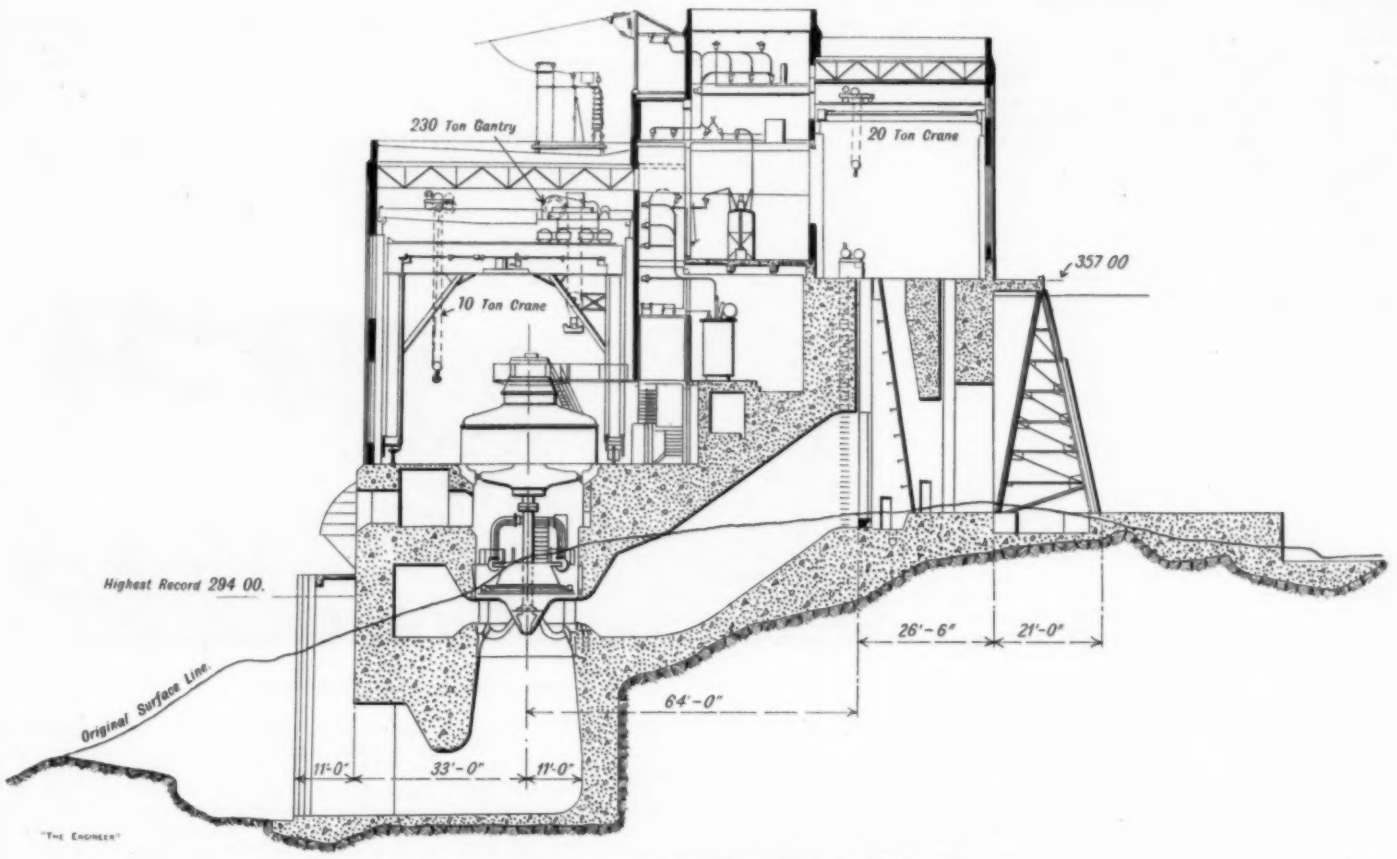


FIG. 4—CROSS SECTION THROUGH POWER-HOUSE—BRYSON STATION

GREAT FALLS STATION ON THE WINNIPEG RIVER.

Outstanding among the hydro-electric power developments in Western Canada is the Great Falls plant of the Manitoba Power Company, on the Winnipeg River in the province of Manitoba situated about 75 miles from the city of Winnipeg. This plant, a general view of which is given in our Supplement of to-day, has an installed capacity of 112,000 horse-power, and an ultimate capacity of 192,000 horse-power. The past year marked the coming into operation of the fourth 28,000 H.P. unit, and the extension of the power station superstructure to include units 4, 5, and 6. The company has announced its intention of proceeding with the installation of the final units 5 and 6, which are to be of 40,000 H.P. each.

Coincident with the coming into operation of the fourth unit, it has also been necessary to increase the transmission lines capacity from the plant into the city of Winnipeg. That has entailed the construction of a second steel tower two-circuit 110,000-volt transmission line from Great Falls to the new terminal station, which the Winnipeg Electric Company—parent of the Manitoba Power Company—recently built in Winnipeg. The transmission line and terminal station represent an investment of 1,500,000 dollars. The new transmission line traverses territory entirely different from that of the original transmission line, a feature which will undoubtedly prove valuable in helping to assure continuity of service. The lines are separated some 40 miles distant from one another. An interesting feature of the new line is the height of the towers constructed at the point where the new circuits cross the Red River from East Selkirk to West Selkirk. The span at that point is 2047ft., and each of the towers crossing the river is 230ft. in height and 40ft. square at the base.

The Winnipeg River lies almost entirely within the province of Manitoba. It drains an almost circular area of 53,000 miles, 11,000 square miles of which are in the State of Minnesota, 37,900 in the province of Ontario, and 4600 in Manitoba. Dotted in all directions at the head of the Winnipeg River are 110 lakes, ranging in size from 2 to 1500 square miles, the largest being the Lake of the Woods. The Winnipeg River forms the connecting link between Lake of the Woods and Lake Winnipeg. Leaving Lake of the Woods, the river flows in a north-westerly direction, widening into deep lake-like expanses with little or no current, and again narrowing into channels and forming rapids. This characteristic formation continues through the entire length of the river, a distance of 150 miles between the two lakes.

These lake-like expanses along the river's course are available for large storage reservoirs at the various power sites to assist in equalising the flow of the river. Between the two lakes there is a drop of 347ft.,

which is comprised in a series of falls. Of the total fall, about 275ft. is on the river within Manitoba, which, with a minimum regulated flow of 20,000 cubic feet-seconds, is estimated to produce 418,000 horse-power continuously. The total precipitation within the drainage area of the river over a period of years has been sufficient to give 25,000 cubic foot-seconds continuous flow, from which could be produced over 500,000 continuous horse-power, all of which is within 50 to 90 miles of Winnipeg City.

Realising the importance of water power resources to the future development of Manitoba, the Canadian Government in 1911 began a survey of the Winnipeg River basin with the object of ensuring the maximum utilisation of the power resources of the river within the province of Manitoba. That survey was completed in 1915 and provided for utilising the eighteen falls in the river at seven sites. This survey not only decided upon the proposed power sites and the methods controlling the flow of the river, but also worked out the tentative design of the barrage and power station that should be constructed at each site.

It was at the du Bonnet Falls site, the highest head—56ft.—on the river, that the Manitoba Power Company constructed its Great Falls plant. This site includes three falls:—Whitemud, 12ft.; Little du Bonnet, 9ft.; and Grand du Bonnet, 35ft. By constructing a barrage at Little du Bonnet Falls it was possible to flood out the 9ft. and 35ft. falls and to raise the headwater level to that of the tailwater level of the proposed site above. Whitemud Falls is about 3 miles below Little du Bonnet Falls, and is formed by a granite ridge about 1800ft. long across a deep basin between the two falls. By cutting a channel, 200ft. wide and 20ft. deep, in this ridge, the water level back to the power site was lowered about 10ft., making a total operating head of 56ft.

The proposal of the Government engineers was to construct the barrage at Little du Bonnet Falls, but investigation by the power companies' engineers led to a decision to construct the barrage and power-house below the falls at what is known as Island No. 2. The barrage was built of a height sufficient to raise the original water level 46ft., and by lowering the original water level below the barrage 10ft., a total head of 56ft. was obtained, for which head the turbines were designed. Since the island divided the river into two channels, it was possible to close the west channel by a cofferdam, and pass all the water through the east channel, while the gates and wheel pit openings in the power-house were being constructed in the former. When this work was completed, all the water was passed through those openings while the barrage was constructed in the east channel.

Beginning at the west bank of the river the first section of the barrage, which extends from the shore to the power-house, is approximately 750ft. long, is of the non-overflow type, is of solid concrete, and has a maximum depth of 70ft., with its crest elevation at 816ft. The next 391ft. of the barrage comprises the power-house, from the east end of which a concrete wing barrage extends 100ft. upstream, and includes a skimming weir, over which is discharged ice and other floating material deflected from the power station by a curtain wall, which extends 8ft. below normal water level. From the end of the wing barrage the next 260ft. is the same as the section extending from the power house to the west bank. From that point a 400ft. spillway, with a crest elevation at 808ft., and provided with flashboards to raise the elevation to 810ft., has been constructed. At the east end of the spillway there are four steel sluice gates. These gates, which are on the crest of the island, are 30ft. high by 50ft. wide, and are designed to pass the maximum flow of the river. For 200ft. east of the sluice gates the barrage is of the non-overflow concrete type with elevation at 816ft. Across the east channel the barrage for 1000ft. is of the rock-fill type, and on the east bank the barrage is an earth embankment 1100ft long with a concrete core wall. This gives a total length of barrage and power house of nearly 4500ft.

The power-house, an interior view of which is given in Fig. 3, is 110ft. wide, 391ft. long, and has a maximum height of 145ft. The foundations are of reinforced concrete and carry a structural steel superstructure with concrete curtain walls. The roof is a concrete slab covered with felt roofing. The power-house proper contains four vertical turbo-generators, with provision for two more. There are the usual intake racks, stop logs, head gates, &c. At the entrance to the scroll case for each use are three pairs of steel head gates. The gate openings are of sufficient dimensions to pass the flow required for each turbine at a velocity of 4·5ft. per second. Screens consisting of heavy steel bars, 6in. spacing, supported on steel framework, are also placed in the intake. Stop logs can be employed at the entrance to the water passages for closing off the water to facilitate inspection and maintenance of the gates. A 30-ton travelling crane is provided in the gate-and-screen house for handling screens and gates.

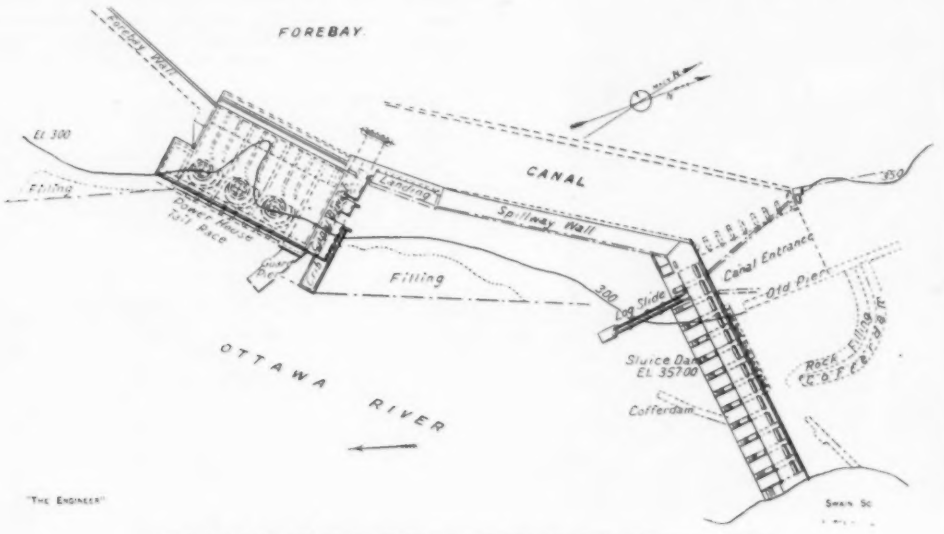


FIG. 5—PLAN OF THE BRYSON STATION ON THE OTTAWA RIVER

In the west end of the station there are two sluiceways to allow of the passage of flood water in the winter when the gates are frozen in the spillway. These sluiceways are 13ft. by 24ft. at their intake end and 10ft. by 15ft. at their outlet. This design results in a gradual acceleration of the water, and prevents local vacuum or eddies forming within the sluiceway. The entrance to the sluiceways is closed by Stoney-type motor-operated gates.

Among the most interesting features of the installation are the turbine runners, which are of the high-speed propeller type. These runners have a throat diameter of 15ft. 9½in., and are 4ft. 6in. high. They are cast in one piece and weigh about 72,000 lb. They run at a speed of 76 r.p.m., and the peripheral speed is high, being about twice the spouting velocity of the water under a 56ft. head, or 7000ft. per minute.

Each turbine is connected to a 21,000 kW three-phase 60-cycle 11,000 volt alternator. These machines have a guaranteed efficiency of 97·1 per cent. Excitation is supplied by a direct-connected 150 kW exciter on each machine, mounted above the thrust bearing. The entire weight of the revolving element is carried on a Kingsbury-type thrust bearing supported on the generator's stator frame. This bearing is designed for a load of 950,000 lb. at the rated speed of the machine, and is provided with water-cooling coils.

The 11,000-volt leads of each generator go directly to a 21,000 kVA bank of transformers consisting of three single-phase 11,000 to 66,000 volt units connected delta to delta. There are no switches between the generator and transformers. The guaranteed full load efficiency of the transformers is 98·8 per cent.

Towards the end of 1926 the Manitoba Power Company entered into a contract to supply electrical energy to the new mill of the Manitoba Paper Company, at Pine Falls on the Winnipeg River, some fifteen miles from the Great Falls plant. To supply that load it was necessary to build a double circuit transmission line connecting the mill with the power plant. The line roughly follows the river, except where distance could be saved by tangent construction. Owing to the line running through heavily wooded districts subject to bush fires, it was decided to build it with steel towers. The line is designed for the following loading:—

Vertical Loading.—Dead load of structure, plus the load of the cables encased in an annular ring of ice ½in. in thickness, plus 500 lb.

Horizontal.—(*a*) Wind at 8 lb. per square foot of projected area on the cables plus ice cover; (*b*) the effect of a three degree turn in the line; (*c*) such a force at each of the conductor supports, as, taken together, would produce the same moment at the base of the tower as a wind of 13 lb. per square foot on twice the projected area of the tower.

The maximum working load on the cable applied in the direction of the line on any one conductor support. Standard spacing was 800ft. Standard towers have an all over height of 81ft., and a total weight of 5600 lb. The cable used was 266,800 c.m. aluminium conductor steel reinforced, and was strung for an ultimate tension of 4100 lb., when loaded with ½in. ice or 8 lb. wind at zero degrees Fah. At the power-house end lightning arresters of the Westinghouse autovalve type were provided. The line is designed for ultimate working pressure of 110,000 volts, but at present is being operated at 66,000 volts.

The Bryson Station on the Ottawa River.

To its already extensive possession of hydro-electric developments in Canada, the International Paper Company recently added what is known as the Bryson plant, situated near Bryson, Quebec, on the Ottawa River. This plant—a view of which is given in our Supplement of to-day, and which is also illustrated in the accompanying engravings—Fig. 4 on page 137 and Figs. 5 and 6—has an installed capacity of 25,000 horse-power, and a possible development of 75,000 horse-power. It was built by the Ottawa and Hull Power Company.

The Ottawa River, at a point near the village of La Passe, is divided into two channels by the Island of Grand Calumet, the westerly course being known under the name of Rocher Fendue Channel, and the easterly course under the name of Calumet Channel. At a point some 22 miles downstream from the point of division near the village of Bryson, there occurred, over a distance of a little more than one-half mile, through a rocky gorge interspaced with a number of small islands, a series of rapids having an available head of 60ft. The Calumet Channel had previously been maintained by the Dominion Government for the purpose of floating the quantities of squared timber, which, in days gone by, had made the Ottawa River more or less world famous, and at the head of these rapids a timber crib stone-filled barrage had been constructed by the Federal Government for the purpose of controlling the water required for the operation of the log slides, which had been built in order to handle this particular type of timber in such manner that it would not be damaged through a contact with the various islands and rocks in the

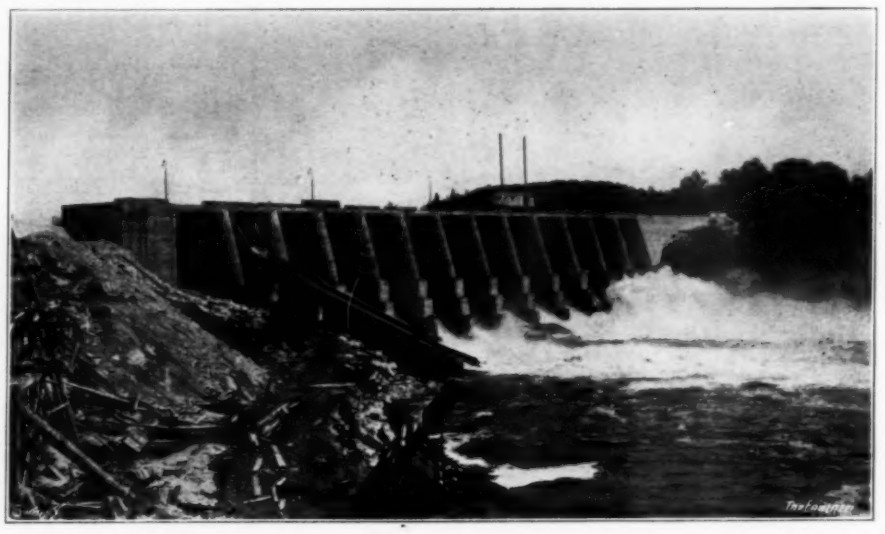


FIG. 6—MAIN BARRAGE—BRYSON STATION

channel. It is interesting to note that this work had been carried out by the Government some one hundred and fifty years ago, and that various portions of the work were found in a remarkably sound condition, particularly the sections which were permanently under water.

The catchment area drained by the Ottawa River at Calumet Falls is 27,914 square miles in extent. Careful water gaugings of the Ottawa River had been taken and accurate records preserved by the Department of Public Works for the past twenty years or more, and, based upon them, the minimum flow of the river at the point of division of the channels was accepted as being 11,700 cubic feet per second. The division of water between the two channels at this point during the low stages of the river was, as the result of investigations also carried out for a number of years, found to be almost exactly equal, although during the higher stages of the river the discharge down the westerly or Rocher Fendue Channel was very much in excess of that through the Calumet Channel, which feature was fortunately to the advantage of the site under development.

The general scheme of development comprised a barrage across the foot of the rapids with the power-house at the mouth of a small gully, which constitutes the forebay, and a canal cut through the solid rock of the river bank to convey the water impounded by the main barrage to this forebay.

The first actual development work to be undertaken consisted of the construction of the main cofferdam at the head of the rapids and immediately in front of the old Government barrage. It was at first considered possible that this old barrage might be utilised, with relatively slight additions, and incorporated in the main body of the cofferdam, but, upon investigation, it was found that it was not sufficiently watertight and that it would be more economical to use this old structure as reinforcement for a new timber crib barrage to be built immediately in front and waterproofed in the usual manner with sheeting.

The greatest depth encountered in this work at this point was not in excess of 20ft., and no unusual difficulty was experienced in satisfactorily shutting off the flow of this channel. Under ordinary conditions, the level of the yearly flood waters at the site of this cofferdam almost immediately opposite the village of Bryson, controlled by the normal division of the water at the upstream end of the island, was found to be at elevation 347·5, and during the period of maximum flood at elevation 351·7. These elevations would obviously limit the maximum elevation of the pond level of the proposed works, which was accepted for normal operation as elevation 350. The natural fall along the stretch of the Calumet Channel from La Passe to the site of the old Government barrage was found to be approximately only 2½ft.; that is to say, that, with the still water level raised to elevation 350 at the head of the island near La Passe, the corresponding water level at Bryson required to discharge the normal flow of the river would be 347·5.

During the ordinary and low-water stages of the river, the water of the Calumet Channel could be diverted and passed down the western channel without inconvenience or damage, but, during the high-water period, owing to river improvements, which had been carried out by the Upper Ottawa Improvement Commission for the purpose of handling logs, provision had to be made to discharge a sufficient quantity of water over the cofferdam to protect these works. Accordingly, a contact was established during flood periods with the other side of the island by telephone, in order that provision could be made to protect their situation by control effected through the use of flash boards mounted on the crest of this barrage. By this means, any possibility of being required to pay damages to the other interested parties on the river was obviated.

The barrage—see Figs. 5 and 6—was erected immediately above the foot of the rapids at a point where the river was relatively shallow, and advantage was also taken in the construction of including a certain portion of an island in midstream. A restriction occurred in the bed of the river at this point, which rendered the cross section quite narrow, but, on account of the large spillway area required to discharge the spring floods, the entire crest area was required for that purpose, and, in consequence, the power house was not included as an integral portion of the barrage, but was situated some little distance downstream and connected by a canal excavated along the western bank.

The barrage is a concrete gravity section, 380ft. long and 70ft. high, containing twelve sluices and a log slide of V-section, all covered by a reinforced concrete deck. The sluices are all 20ft. in width with the crest of the barrage at elevation 321, which with the normal operating level at elevation 350 places the depth of the sill below high water at 29ft. A cross section of the power-house is given in Fig. 4.

The water level is controlled by stop logs handled by a 30-ton travelling stop log hoist electrically operated by direct current supplied at 220 volts by a series of outlets placed on concrete pedestals along the downstream edge of the deck. The eastern abutment of the barrage is built into and against a high bank of solid rock, and the western abutment stands alone and forms the commencement of the downstream wall of the canal which was excavated to carry the water to the forebay.

The canal is of rectangular section, 90ft. wide by 540ft. long, with the floor at elevation 313, utilising as the western wall the natural rock face of the excavation, whilst the outstream or eastern wall is a concrete gravity spillway section, 34ft. high, extending from the west abutment of the barrage over a distance of 300ft. to the landing platform at the north end of the power-house. A by-wash, controlled by cast iron gate sections, is also provided between the platform and the power-house to facilitate the handling of trash or possible ice.

Accepting the normal operating elevation of the head water at 350 the depth of water in the canal would be 37ft., giving a cross-sectional area of 3300 square feet, and with the plant operating at full operating capacity this provides for a maximum velocity of 3·6ft. per second. At the entrance of the canal is a row of seven piers, the tops of which are at elevation 331, spaced at intervals of approximately 14ft., so arranged that in the event of it being desired to unwater the canal stop logs can be inserted.

The superstructure of the power-house is 238ft. long by 125ft. in width, not including the platform. It is of common brick, faced on the outside with a high-grade buff pressed brick. The design of the power-house is arranged in three main sections, namely, gate house, switch house, and transformer compartments, and generator-room, which arrangement is the outcome of requirements for stability, necessitating an overall width of section, leaving sufficient space between the gate house and generator-room for the accommodation of all necessary electrical equipment beyond the generator. Gypsum was used throughout for the roofs on account of its lightness and the consequent saving in the weight of the roof trusses, and also due to its non-sweating properties.

A double set of racks is provided at the entrance to the intake, with the outer section of coarse spacing, so as to afford a maximum amount of protection against heavy drift, which may be reached by the operators on the rack platform and carried along so as to be discharged through the by-wash at the end of the spillway section of the canal. The gate house is completely enclosed and heated, in order to eliminate any possibilities of ice troubles occurring in the operation of the gates during the cold weather.

A full set of emergency crane-operated gates, 15ft. wide and 41ft. high, is provided for one unit. The gates, which are of steel, are of the fixed roller type. Each gate is in two sections, and when not in use can be stacked on edge in the gate house. The head gates proper, 15ft. wide by 21ft. high, are of the live roller type operated by rope hoists, with individual motor drive and are designed to close with the full head of water on an operating unit at full load.

Although full provision has been made for the ultimate reception of three units, the initial installation consists of one vertical shaft turbine unit capable of developing, when operating under a net head of 60ft., a total output of 25,700 H.P., or 22,500 H.P at seven-eighth gate opening at a speed of 120 r.p.m., the runner being of the usual Francis type with a guaranteed efficiency when operating at seven-eighth gate opening of 88 per cent. The unit is controlled by an oil pressure governor driven by bevel gears from the turbine shaft, equipped with the usual hand-controlled mechanism gate-opening indicator, adjustable gate limiting and the usual safety shut-down devices operating on two motors direct connected to the gate ring. The turbine is direct connected to a 22,500-kVA, 80 per cent. power factor, 80 deg. Cent. temperature rise, alternating-current, three-phase, 6600-volt generator, with direct-connected exciter. The generator is equipped with an overhead thrust bearing designed to carry a weight of moving parts and thrust amounting to 650,000 lb. Compressed air for operating the generator brakes is supplied by a separate motor-driven air compressor. Stand-by excitation is also arranged for through the provision of a 200-kW, 250-volt, direct-current generator, direct-connected for the operation of an induction motor of suitable size for continuous operation with 50 deg. Cent. temperature rise.

The generator is connected through a low-voltage oil circuit breaker, directly to the low-tension side of a bank of three 7500-kVA, oil-insulated, water-cooled, shell-type, single-phase, 41,600/6600-voltage indoor type transformers, there being no low voltage buses between the generator and the transformer bank. The transformer rooms are isolated by fire-doors, and similar protection against fire has been made throughout the building.

On the floor above the transformer rooms are installed the generator high-tension oil circuit breakers connecting in the high-tension bus, together with high-tension line circuit breakers. The two upper floors are devoted to the placement of the necessary bus structures and disconnect switches. A very complete system of high-tension buses and switching equipment, taking into consideration every possible contingency, has been provided for. Provision is made for the erection of a set of 46,200/69,300-volt, three-phase, outdoor-type, oxide-film lightning arresters on the roof of the generator-room for each outgoing line.

At the north end of the generator-room and on the main floor level are arranged two 5in. double-suction, single-stage centrifugal pumps, direct-connected respectively to a 20 H.P., direct-current and an alternating-current motor, each having a capacity of from 400 to 600 Imperial gallons per minute, for the purpose of supplying cooling water for transformer and all other services in the plant. Water is taken underhead directly from the forebay through mechanical filters, so arranged that the cleaning of the screens can be effected without interruption to the supply of water. The heating of the building is provided through the installation of two 30 H.P. horizontal oil-fired boilers installed in a separate room, also situated at the north end of the power-house, operating under a pressure of 30 lb. per square inch. Power for the operation of the motor generator set, station lighting and local plant distribution purposes is arranged for through the installation of a bank of three 500-kVA, 6600/2300-volt, single-phase transformers.

All motors for the operation of the cranes, gate hoists, stop-log winch, pumps, &c., are installed for operation on direct current normally supplied from the motor generator set, but, as it was anticipated that, during the commencing period of operation, only one unit would be installed and one single-circuit transmission line constructed, it was apparent that, in the event of trouble occurring on this line during any period while the unit might be undergoing examination or repair, the plant would be left without any source of power for the operation of the auxiliary equipment. With that contingency in mind, a hot-bulb engine direct connected to a 150-kW, 220-volt, direct-current generator was installed in the north end of the power-house. This unit incidentally proved to be of inestimable value during the erection period and when the line was already overloaded, while providing for the requirements of the contractors and operating at the low voltage of the Ottawa supply.

Notes on the Design of Propellers.

By G. S. BAKER, O.B.E., M. Inst. N.A.

No. II. (*Conclusion*).*

Blade Sections.

The standard type of propeller in which the blades are formed with cross sections having circular backs has come down to us from our forefathers. It is a type of blade which, even with crude shaping and finish, will give a result not strikingly bad, and it is well "dug in" in the trade. But in the brother industry of aeronautics, starting from modern data, the designers have evolved propellers with distinctly better efficiencies than what would be obtained from circular back sections for their blades, and there seems no reason to suppose that in some cases marine screws cannot be improved by following their methods. With this in view I wrote a series of articles in the *Liverpool Journal of Commerce* in 1913–4 drawing attention to the advantages of the aerofoil type of section and its possible pitfalls under some conditions. A propeller with such sections was fitted on one of two sister ships built by Messrs. Esplen, Son and Swainston in 1914, and comparison of these two on the first year's running showed a mean increase in speed of 0·25 knot without increase in fuel.

Since then several other suitable ships have been fitted with such propellers drawn out at the national tank, and, in these, improvement has been quite definite. There are, however, limitations to the use of this type of propeller blade, and in order to explain them it is necessary to introduce a little theory.

The term aerofoil section is used here to define sections similar to those in use for the wings of aeroplanes; their number is legion, but not one attains the ideal of serving every purpose. When a ship propeller is working, the backs of the blades are sucking the water from in front towards the screw disc, and in doing so the back surfaces are subjected to reduction of pressure or suction. In addition, the driving faces are thrusting the water back, thus completing the formation of the race, and in doing so are subjected to high pressure over their surfaces. These two together—high pressure on driving face and low pressure or suction on back—constitute the thrust of the propeller. The action will be considered in some detail later on. Briefly, it is desirable to produce, in front of the propeller, as high a flow as possible, as this is conducive to high efficiency. The development of the suction on the backs of the blades promotes this early flow. In certain conditions the adoption of aerofoil sections develops this suction to a greater extent than circular back sections. The case seems fairly simple at first sight; one has but to work out the real slip angle at any point on the blade and to choose a section of the correct camber to chord ratio which gives the highest suction ratio at this angle and the work is done.

We come now to the consideration of the qualities required of an aerofoil section when it is to be used in a propeller. In aeronautical terms these cross sections will have a high lift to drag ratio, *i.e.*, a high ratio of thrust (lift) to drag (or resistance). Unfortunately, the conditions under which ship propellers have to work vary considerably, and slip angles will also vary, not only between light and loaded ship, in fine and rough weather, but even in the course of a single

* No. I. appeared August 3rd.

revolution, as the blades sweep from the slow water on the middle line plane of the ship, to the much faster moving water at the outer parts of the screw disc. This brings us to the first and broadest limitation of the use of such sections, *i.e.*, that they must possess a higher lift to drag ratio than a circular back section of the same camber *over a wide slip angle range*, or they will give worse results. The slip angles for an average merchant ship doing 14 knots on 450ft. length, with moderate revolutions, vary from, roughly, 6 deg. at the blade tip, to 8 or 10 deg. near the root or boss. These are mean slip angles, and in the course of a revolution in the mixed wake behind a ship they will vary from roughly 3 to 10 deg. at the blade tip, and from 7 to 12 deg. near the boss.

Effectively to choose such sections it is necessary that one should have a good working idea of the main

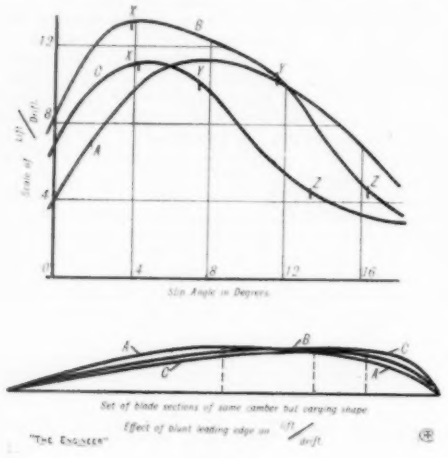

Slip Angle in Degrees
Set of blade sections of same camber but varying shape
Effect of blunt leading edge on lift/drift
"The Engineer"

FIG. 1

characteristics of all aerofoils when used as pressure surfaces. Fig. 1 gives the sections of three aerofoils and their curves of lift to drift. On all such curves three points need to be watched; these are marked X Y Z in the figure. Point X is the angle of maximum lift to drag, Y gives the maximum lift coefficient, *i.e.*, the lift does not increase for any reasonable increase of slip angle beyond that at Y (with some sections it falls off with increase in angle.) Over the region Y-Z the lift is decreasing and drag rapidly increasing.

For any flat-faced aerofoil, these characteristics depend broadly on two features, the ratio of the thickness to the length of the section, and the shape of the leading portion of the cambered back. It is found that with increasing camber ratio up to roughly 0·05, lift of drag increases, and with higher camber ratios progressively decreases. The position of the point

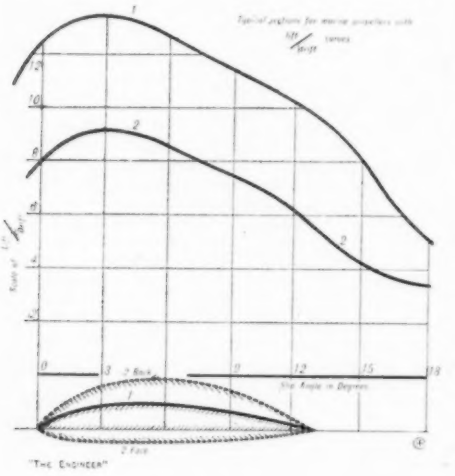


FIG. 2

X does not change materially with camber ratio in similar blade sections. The drop in lift from Y to Z increases both with camber ratio and with bluntness of leading edge, and these same changes cause the point Y to move to smaller angles. These effects of increasing bluntness can be seen from the three curves of Fig. 1. These are for sections of the same camber with the maximum ordinate shifted to different positions. Blunt end C is useless above 8 deg.; A and B can be used up to 12 deg.

If the camber ratio is either very small or very great, the points X and Y tend to get close together, but in thin blades the drop from Y to Z is comparatively slow.

The desirable slip angles for a propeller blade lies between X and Y, and the desirable section must give a high lift to drag ratio over this region. It is not a difficult matter to find aerofoil sections satisfying any reasonable conditions for the outer portions of the blades, and generally very much the same type of section can be used for some distance in from the tips. Towards the boss, however, with uniform pitch, both the slip angle and the camber ratio grow large. If the former approaches within some 3 deg. of the point Y on the characteristic curve for the chosen section, that section should not be used. The higher the camber ratio the more difficult it is to find sections that will give good results. In such cases there are three possibilities. First the slip angle at root may be decreased by tipping the section to bring the pitch down a little. This is effective only when a section is available for which the points X and Y are a good distance apart. Secondly, the section may be made less blunt at the leading edge, the maximum ordinate being placed at or near the centre of length, *i.e.*, one reverts to something approaching a circular back.

Distribution of pressure on face and suction on back of flat plate and aerofoil blade at various slip angles.

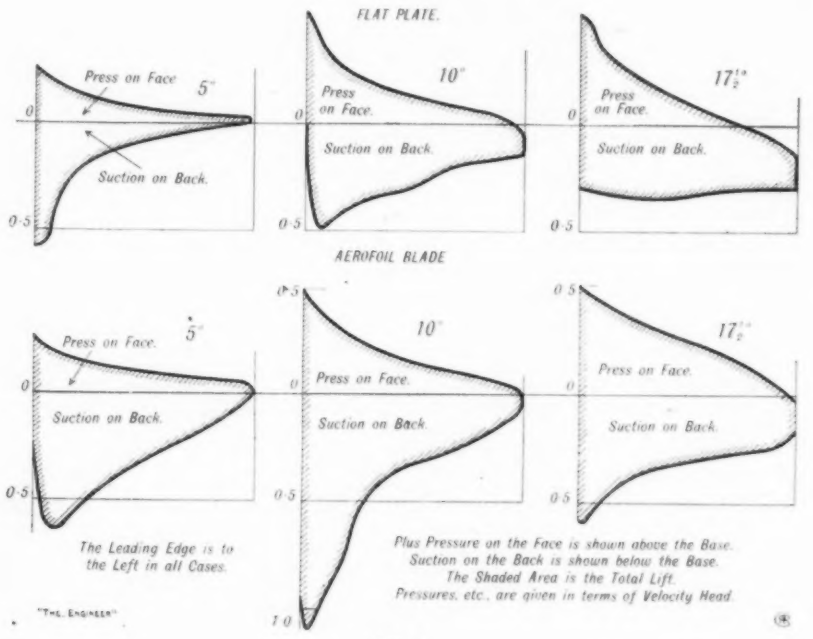


FIG. 3

Thirdly, not all the thickness should be placed at the back of the section. The face can be rounded out slightly, and some sections of this type are available for use. This is useful for the built-up propeller, as the shape accommodates itself to the placing of the holding bolts in the palms of the blades. Either of these methods, or any combination of them, may be adopted to suit any individual propeller.

Fig. 2 shows two typical sections which have been used. The one is flat faced; the other is rounded on the face and is intended for root sections of high camber ratio. These sections give a good working range of slip angle with high lift to drift. There are, of course, other possibilities in this direction which will satisfy requirements, but the limitations and the danger spots are the same for all of them.

Cavitation.

One other aspect of the case has to be considered for high-speed ships. With destroyers, cross-channel steamers, and, as a rule, with shallow draught vessels, the thrust per unit developed area of blade is high, and this necessarily involves the possibility of a breakdown in the propeller action. It is known from practical experience that the maximum allowable mean pressure per square inch of developed blade surface can be taken as 13·5 lb. in a turbine driven deeply immersed propeller with good blade tip clearance, but that with a four-cylinder single-acting oil engine this drops to about 9·0 lb. per square inch, and in order to allow a margin for rough weather it is not good to work above 7·0 lb. in the latter case. The more uniform the engine drive the higher this figure can be taken. With small clearance or bad wake conditions, it must be reduced. Now these figures have been derived from experience with propellers having "circular" back blades. The increased thrust derived from an aerofoil blade is almost entirely obtained by the suction effect of its back.

In Fig. 3 are shown the distribution of thrust on driving face and suction on back of blade for a flat blade and an aerofoil surface, at three different angles. The total thrust is the sum of the positive thrust on the driving face and the suction on the back. The positive thrusts on both blades are very similar in amount and distribution over the blades. But the suction on the back of the aerofoil near its leading edge reaches a value of $1 \cdot 2\ \rho\ V^2$ at 10 deg., and rises to $1 \cdot 5\ \rho\ V^2$ at about 12 deg. working slip angle, whereas the flat plate only attains $0 \cdot 6\ \rho\ V^2$. Now the blade section for which these suctions were obtained is not abnormally blunt, and these curves can be taken as fairly representative. The blunter the leading edge the relatively more local is this high suction. At large angles this high local suction breaks down and tends to a uniform value much the same as on a flat plate. The blunter or thicker the section the smaller the angle at which this occurs. All so-called aerofoil sections are blunter than a circular back section of the same thickness, and will therefore be *subject to higher local suction* near the leading edge. It is not advisable to use such sections when cavitation limits are being approached, but, on the contrary, it is believed—although I have not been connected with any test of the idea—that it would be advantageous to keep the maximum ordinate of the section a little towards the trailing rather than leading edge.

One other limitation of the use of these aerofoil sections is when the blade tip clearance is small. As the blade passes close to the hull, the slip angle is high, and although the suction tends to be more uniform at the tip than on the rest of the blade, it will break down earlier than with a circular back section. The situation can be eased a little in such a case by skewing back the blade, so that the water is partially set in motion before reaching the tip.

One note may be added *re* the finish of the blades. It is necessary that they shall all be alike, otherwise unequal thrusting will occur, and possibly vibration be set up. She-templates should be made for the back, and all the blades should be finished to the same set.

Recent Naval Construction.

The month of July witnessed a series of warship launchings which deserve special notice by reason of the novel design of most of the vessels concerned. First in importance was the launch of H.M.S. "Shropshire," at Beardmore's yard, Dalmuir, on July 5th. This ship is the fourth unit of the "London" class, which closely resembles the preceding "Kent" group in general dimensions, but is equipped with more powerful machinery. The "Shropshire" and her sisters are accordingly expected to attain a speed of 32½ knots, as against the 31½ knots of the "Kent." The lines of the hull have been fined down by omitting the external bulge, which is a feature of the "Kent," but it is claimed that underwater protection has not been impaired by this modification. Incidentally, the four "Londons" were the first cruisers of the 10,000-ton class to be designed by Sir W. J. Berry, the present Director of Naval Construction.

On July 17th another cruiser, H.M.S. "York," was put afloat from the Palmer Shipbuilding Co's. yard at Jarrow, the naming ceremony being performed by the Duchess of York. This vessel is the first of the "B" cruisers to take the water. They represent a compromise between the 10,000-ton type, which suffers under the drawback of excessive cost, and the fleet cruisers built under the war programmes, which are too small and of too restricted a radius to be of much value for service on the ocean trade routes. The standard displacement of the "York" is slightly over 8000 tons, and it is announced that she will carry six 8in. guns. We are glad that the Admiralty decided against a 6in. armament, which had been recommended in some quarters. To arm our "B" cruisers with 6in. guns would have been to render them helpless against the 10,000-ton 8in.-gun ships which they would probably have to encounter in war. Mounting weapons of equal calibre and weight, however, they need not shrink from action

with these larger opponents. It is to be hoped that all our future cruisers will be provided with an 8in. armament unless or until the other Naval Powers revert to guns of less calibre. The British Government has twice advocated the limitation of cruiser guns to 6in., and as this proposal has not found favour abroad, we have no option but to retain the 8in. weapon in our new ships, despite the reduction in tonnage.

The third vessel to be launched for the British Navy last month was H.M.S. "Medway," a submarine depôt ship, which went afloat at the Vickers-Armstrong yard, Barrow-in-Furness, on the 19th. The "Medway" is the first of four auxiliary ships included in the five-year naval programme adopted in July, 1925. She will take the place of the "Maidstone," which has now been transferred to the disposal list. The displacement of the "Medway" has not been published, but her length between perpendiculars is 545ft. Accommodation is provided for all the officers and crews of submarines attached to her in addition to her own complement and repair staff. The extensive workshops on board include a foundry, machine shop, plate shop, smithy, torpedo shop, and plumbers' shop, all of which are equipped with the latest plant. Some notes on the propelling machinery, which consists of two sets of double-acting, two-stroke, internal-combustion engines, built by Vickers-Armstrongs under license from the M.A.N. firm at Nuremberg, have already appeared in our columns. These engines are the first of their type to be manufactured in the British Isles, and at the time when the contract for the "Medway" was booked, they were the largest engines which had been designed by the M.A.N. people. Since then, it was stated at the launch, Mr. Callender, the Vickers-Armstrong engineering director, has seen running in Germany a M.A.N. engine of 12,000 B.H.P. The machinery equipment of the "Medway" constitutes the best evidence of the Admiralty's practical interest in the development of the I.C. system.

On July 18th the Argentine flotilla leader "Mendoza" was launched by J. Samuel White and Co., at Cowes. This is the first of three sister vessels ordered from the company by the Argentine Government a year ago, in the teeth of keen competition by continental shipbuilders. The "Mendoza" is 335ft. long overall, 31ft. 9in. in moulded breadth, and has a displacement of about 1800 tons. She will be driven by two sets of Parsons type single-reduction geared turbines, supplied with steam at a pressure of 250 lb. There are four three-drum, small-tube boilers, which are the largest of their type so far manufactured for marine service. Vickers-Armstrongs are responsible for the armament, which consists of five 4·7in. guns, one 3in. and two 0·40in. A.A. guns, and six 21in. torpedo tubes on triple-mountings. While it is satistactory that a British firm should have secured this important business, it is evident from speeches made after the launch that the contract is not a particularly lucrative one. The completion of these three fine vessels will add greatly to the strength of the Argentine torpedo flotilla, which already includes two modern leaders, also of British design, that were purchased from the Spanish Government last year. Another large foreign naval contract now in hand is that for the six Chilean destroyers, which J. I. Thornycroft and Co., of Southampton, booked over twelve months ago. Four of these vessels are already in the water, the "Serrano" having been launched in January, the "Orella" in March, the "Riquelme" in May, and the "Hyatt" on July 21st. The "Serrano" returned to Southampton at the end of July on completing her speed and endurance trials, the results of which, we are informed, were most satisfactory, the contract conditions having been exceeded. This vessel, an illustration of which was given in our last week's issue, has been built in record time.

A fairly large amount of naval tonnage is now on the stocks in this country, including the 10,000-ton cruisers "Dorsetshire" and "Norfolk," which are being built in Portsmouth Dockyard and the Fairfield yard at Govan respectively, and the 8000-ton cruiser "Exeter," the keel of which was laid at Devonport on August 1st. The big repair ship "Resource" is under construction by Vickers-Armstrongs at Barrow, the flotilla leader "Codrington," by Swan, Hunter and Wigham Richardson, and two mine-sweepers by Hawthorn Leslie. Eight destroyers and ten submarines are also being built by contract, besides two submarines at Chatham. While this list seems an impressive one numerically, the actual sum of tonnage involved is, of course, very far below the average in pre-war years, and it is undoubtedly the fact that naval contracts have ceased to count as a major branch of business to our shipbuilding industry. This notwithstanding, such contracts are welcome enough at the present period of depression, and disappointment has been caused by the Admiralty's announcement that three ships of the 1928 Navy Estimates, which were originally to have been put out to contract are, in fact, to be built in the Royal Dockyards, viz., a submarine depôt ship at Chatham and two sloops at Devonport. No reason has been vouchsafed for this change of plan, but the shipbuilding community is probably right in attributing it to the influence of the Dockyard M.P.'s, who have been noticeably active of late in the interests of their constituents.

While the directors of our heavy industries are second to none in desiring the promotion of peace and goodwill among the nations, it cannot be denied that they are peculiarly, not to say painfully, interested in the movement to effect a further limitation of naval armaments. It has never been possible to measure the full effect of the Washington Naval Treaty on British shipbuilding and kindred trades, but the almost complete cessation of battleship construction over a long term of years, coupled with the reductions made in the cruiser programme, have unquestionably dealt these industries a heavy blow. In the normal course of events the Admiralty would probably have been ordering capital ships at the rate of two a year from 1921 to 1930 inclusive, and as each ship would certainly not have been less than 40,000 tons in displacement, the volume of such construction alone would have amounted to 800,000 tons for the ten years in question. Had lighter craft been built in equable proportion, the total output of warships during that period must have been considerably in excess of a million tons.

Owing to the Washington agreement, however, only a tiny percentage of this naval tonnage has been ordered. It is obvious, therefore, that naval limitation is responsible in no small degree for the depression which has afflicted our heavy industries of late years. Should the recent negotiations between the British and French Governments eventuate in a new agreement for the restriction of navies, a further decline in the number of Admiralty contracts must be anticipated. The only consolation left to the shipbuilders is the reflection that their loss is the country's gain, assuming, of course—what many people take leave to doubt—that any further reduction in the strength of the British Navy would really be in the best interests of this country.

Depth of Locomotive Tire Flanges.

On January 13th last a passenger train on a branch line of the Great Western Railway was completely derailed. The accident was not directly connected with the locomotive, and was in every sense a minor one, which would ordinarily have received little attention. The fact was, however, brought out in the report of Lieut.-Colonel Mount, who inquired into the accident, that the Great Western Company, "as a result of certain derailments on the system and elsewhere," had adopted "what appears an eminently desirable policy of deepening all engine flanges by $\frac{1}{16}$in."

The contour of locomotive tires for British railways was the subject of British Engineering Standard Association specification No. 276, which was approved on behalf of the main committee on locomotives of that body in February, 1927, and issued in March, 1927. Three contours —A, E, and G—were adopted, which respectively gave a width of $1^{5}/_{64}$in., $^{59}/_{64}$in., and $^{61}/_{64}$in. The recommended use of each shape was as follows:—

(*a*) That the leading and trailing wheels of bogies, the wheels of pony trucks and radial axles or any pair of wheels which constitute the leading or trailing wheels of a locomotive, whether tender or tank, shall have tires of contour A.

(*b*) That the leading wheels of a set of coupled wheels, when led by a bogie, pony truck, radial axle or any pair of carrying wheels, shall have tires of contours A or G.

(*c*) That the trailing wheels of a set of coupled wheels, when followed by a bogie, pony truck, radial axle or any pair of carrying wheels, shall have tires of contours A or G.

(*d*) That coupled wheels, other than the leading and trailing coupled wheels of groups 6, 8 and 10 coupled, shall have tires of contours G or E.

(*e*) That the use of wheels without flanges shall be discouraged.

In each case the depth between the head of the rail at the point of contact with the tread of the wheel and the bottom of the flange is 1$\frac{1}{8}$in. when new. Allowance has to be made for the wear on the inner flange of the wheel, and so that there shall be no contact between the flange and any permanent way fittings, such as crossing chairs and the chairs of check rails, the limit of wear of flanges has been put at $\frac{1}{4}$in., *i.e.*, to 1$\frac{3}{8}$in. below the tread of the wheel.

The change mentioned was, as has been said, not the result of this particular derailment, but of earlier cases of engines leaving the rails at curves. It was in August of last year that the matter came to a head on the Great Western. It was found that in each of the derailments studied the tires were of practically the new full section. Mr. Collett, the chief mechanical engineer, was thus forced to the conclusion that if locomotives ran more safely with a deeper flange, the flange, when new, might be deeper. He thereupon modified the design of locomotive tires, so as to give a maximum depth of 1$\frac{1}{2}$in.—which, incidentally, is the maximum depth found in the United States—and, being satisfied with the result, communicated with the civil and mechanical engineers of the other grouped companies as to whether they would accept Great Western engines with tires having flanges of that maximum depth. In passing, it may be remarked that when the British Engineering Standards Association prescribed standard contours for locomotive tires, the Great Western practice was practically adopted. For the present only the tires of the wheels of locomotives are being dealt with; those of tenders, carriages and wagons will probably follow.

It will be understood that the relation between flange and permanent way fittings remains unaltered; in fact, the maximum permissible wear is being reduced from 1$\frac{1}{2}$in. to 1$\frac{1}{4}$in. As Colonel Mount, in the report mentioned above, observed, "No difficulty is being experienced in regard to contact with permanent way fittings, maximum depth being limited to 1$\frac{1}{4}$in. instead of 1$\frac{1}{2}$in., the existing permissible limit of wear being thus reduced from $\frac{1}{4}$in. . . . to $\frac{1}{8}$in. . . . which more nearly represents the maximum tolerance permitted in practice, treads not being allowed to become hollow by more than this amount."

In writing to us on the subject, Mr. Collett remarks that about twelve months ago he commenced to make all new and re-turned flanges to the 1$\frac{3}{8}$in. depth for bogie and pony trucks, and that for many months the same practice had been applied to all the wheels of locomotives. The extra $\frac{1}{8}$in., although a small dimension, makes a great deal of difference in the appearance of the tire. Moreover, as the increased depth of $\frac{1}{8}$in. on 1$\frac{1}{4}$in. amounts to some 16·6 per cent. increase in the depth of the flange, it is expected to add to the safety of running, when, through exceptional and unavoidable circumstances, the track gets a little irregular.

American Specification for Waterproofing Material for Portland Cement Concrete.

A MASTER specification for integral waterproofing material for use with Portland cement mortar or concrete, which has recently been issued by the Bureau of Standards of the United States Government, contains the following provisions:—

(*a*) The materials covered by this specification are intended to be mixed with Portland cement mortar or concrete for the purpose of rendering them more completely impermeable and water repellent. They shall be stable compounds not subject to disintegration either before or after incorporation with the mortar or concrete with which they are intended to be used.

(*b*) The material shall either mix readily with water or with dry Portland cement, and shall become an insoluble integral part of the mortar or concrete.

(*c*) The material when mixed with Portland cement mortar or concrete shall render such mortar or concrete more completely impervious to water and shall not impair their durability or reduce the compressive strength more than 10 per cent.

(*d*) The waterproofing properties shall be such that when combined in the manner, and in the proportions of waterproofing material to cement, specified by the manufacturers for use with Portland cement mortar and concrete, and tested as specified below, the treated test pieces shall show an absorption of not more than 3 per cent. and shall reduce the permeability—when tested under a pressure of 100 lb.—at least 95 per cent. of test pieces made without the admixture of waterproofing materials, but in all other respects of identical materials, composition, and age.

(*e*) The following tests shall be made for absorption, permeability, and compression.

(*f*) Mortar for tests of waterproofing materials shall be made from Portland cement and sand passing a No. 20 sieve, and held on a No. 50 sieve in the proportion of one volume of cement to four volumes of sand, with only sufficient water thoroughly worked to form a mixture which has a flow of 90 as measured by a cement laboratory flow table. All materials shall be mixed at, and the test pieces be stored in, a temperature of approximately 70 deg. Fah.

(*g*) The waterproofing materials shall be incorporated in accordance with the methods, and in the proportions to the amount of cement, as specified by the manufacturers in their standard directions for the use of their materials.

(*h*) Test pieces shall be made at the same time and under the same conditions of both treated and untreated mortar. The permeability test pieces shall be made in the form of 1in. thick discs in metal moulds. The absorption test pieces shall be made in the form of 2in. cubes in metal moulds. The moulds shall be removed after twenty-four hours.

(*i*) The exposed surfaces of test pieces at the time of moulding shall be struck off with a trowel, and twenty-four hours after moulding all surfaces of the cubes and both faces of the discs shall be brushed with a wire brush to remove any neat cement brought to the surface in moulding.

(*j*) The test pieces shall be kept in a moist closet for twenty-four hours after moulding, then be stored in a damp atmosphere for six days, after which period in the air of the laboratory.

(*k*) The tests shall be made when test pieces have aged twenty-eight and ninety days. In each test each of the treated and untreated pieces shall be tested under identical conditions.

(*l*) Pieces for the absorption tests shall be dried at 212 deg. and 230 deg. Fah. until no further loss in weight is shown. They shall then be allowed to cool in the air to room temperature. The pieces shall be completely immersed in water for twenty-four hours, then be removed, the surfaces dried with a cloth, and weighed immediately. This process shall be repeated daily until the pieces show less than one-tenth of 1 per cent. daily increase in weight. The increased weight of the treated and the untreated pieces shall then be compared.

(*m*) The impermeability tests shall be made by subjecting one side of the test pieces to a water pressure of 100 lb. per square inch, using water free from any visible discoloration or matter in suspension. The test shall be continued twenty-four hours unless a measureable degree of permeability is shown in less time.

(*n*) The degree of permeability shall be calculated in cubic centimetres of water passing through the piece per square centimetre of surface exposed to water pressure. The impermeability of the treated and the untreated piece shall be then compared.

(*o*) Compression tests shall be made of cubes that have been subjected to absorption tests. The cubes shall be tested to complete failure. The resistance to compression of the treated and the untreated pieces shall then be compared.

SLEEPING accommodation for third-class passengers will be provided by the four grouped companies, except the Southern, on and from September 24th, when the new time-tables come into force.

The Hammersmith Storm Water Pumping Station.

The Hammersmith Storm Water Pumping Station, which has been constructed by the London County Council, was formally opened for service on January 20th last by the then Chairman of the Council, Mr. (now Sir) J. M. Gatti. This fine station is intended to pump storm water during periods of heavy rainfall, direct into the Thames near to, and downstream of, Hammersmith Bridge. It is designed to deal with a normal capacity of no less than 1000 tons—or, say, 36,000 cubic feet—of water per minute. Prior to its construction, certain portions of Kensington, Hammersmith, and parts of Fulham suffered severely from flooding in times of heavy rainfall. Since the station has been in full operation, however, we believe that there has been no case of flooding in the area drained by the Pumping Station. Furthermore, the risk of flooding both in the immediate neighbourhood and districts further afield, such as Fulham and parts of Kensington and Chelsea, has been materially reduced, since much of the storm water from the western areas, which formerly had to pass through sewers in times of excessive rainfall by discharging storm water into the River from the higher parts of Hammersmith, North Kensington, Paddington, Hampstead, and Willesden. This sewer, which is nearly 3¼ miles in length, varies in diameter from 7ft. 6in. at the Kilburn End to 9ft. 6in. at the outlet. It has two branches, 4ft. 6in. and 5ft. in diameter, with a total length of nearly 1½ miles. The approximate cost was £420,000. Both it and the Hammersmith Pumping Station discharge into the River below the level of low water.

The Hammersmith relief sewers have been constructed at lower levels than the sewers which they are destined to relieve, and they come into operation only when the flows in those pre-existing sewers exceed predetermined volumes. All the ordinary sewers are of sufficient capacity efficiently to carry, not only the dry-weather flow, but something considerably beyond it. They cannot, however, cope with flows which are the result of exceptionally heavy rainfall. At points at which it is designed to provide relief for them, should the flows, owing to excessive rainfall, exceed a predetermined maximum, weirs are formed in the older sewers. When the level of the water rises above the cills of those weirs, the water flows over the latter and falls into the relief sewer at the lower level. The weirs, of which there are in all six, are arranged at various points throughout the lengths of the sewers. They have fixed cills, but by means of stop boards, which slide in channels in vertical cast iron columns, the level at which overflowing begins may be altered at will. The design of the weirs varies somewhat according to circumstances, and to the positions in which they had to be built, but all are fundamentally the same in operation, and the arrangement illustrated in Fig. 1, which shows the connection of Brook Green Sewer and of what is known as Low Level Sewer No. 2, with the Storm Relief Sewer in Hammersmith-road, may be taken as typical. It will be observed that each of the weirs has three openings.

The storm relief sewers, of course, operate by gravity throughout their lengths, and at the delivery ends their inverts are at 23ft. below Ordnance Datum. The two sewers approach the pumping station at opposite ends of the length of the engine-house, and each is connected through a penstock to a suction culvert which runs immediately below the centre line of the house. The arrangement is shown diagrammatically in Fig. 2, which also shows the discharge culvert to the River. The invert of the suction culvert is 24ft. below O.D., that is to say, 1ft. lower than the

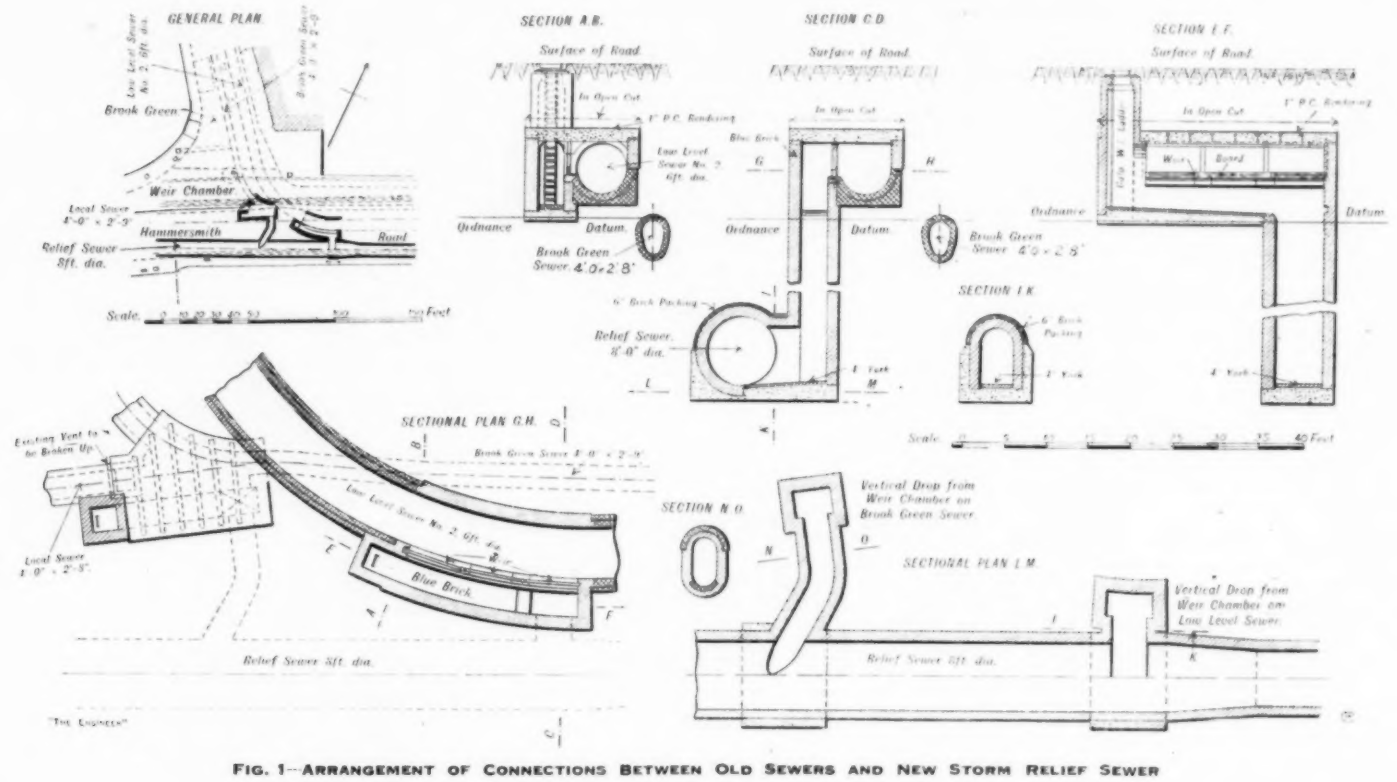


FIG. 1—ARRANGEMENT OF CONNECTIONS BETWEEN OLD SEWERS AND NEW STORM RELIEF SEWER

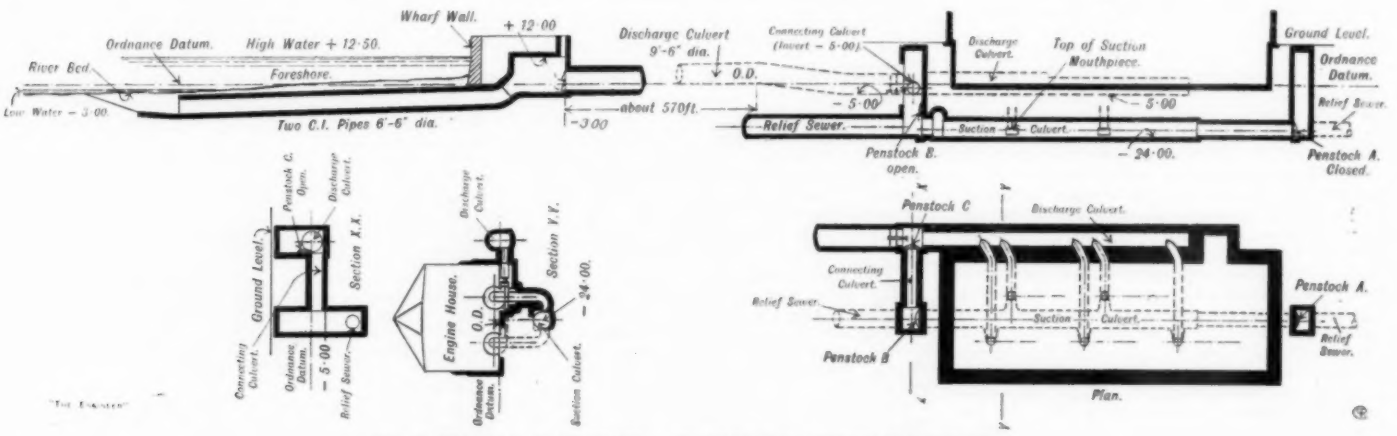


FIG. 2—DIAGRAM ILLUSTRATING SUCTION AND DISCHARGE CULVERTS

In order to make the station effective, it has been necessary to construct and to link it up with two new low-level sewers, which are known as the East and West Branches of the Hammersmith Storm Relief Sewer. The East Branch, which runs approximately north-eastward from the Station, and which is some 6000ft. in length, varies in diameter from 6ft. to 8ft., while the West Branch, which runs approximately north-westward from the Station, and which is 2400ft. long, has a diameter of 6ft. throughout. A delivery culvert to conduct the water raised by the pumps into the River, had also to be constructed. We refer to this culvert more particularly later in this article.

It has already been explained that the station is capable of dealing with 1000 tons of water per minute. To perform that work it is furnished with five pumping units, all exactly similar and having their various corresponding parts interchangeable. Each unit is designed to discharge 200 tons of flood water per minute against a total static lift of 24ft., the total head from all causes being taken as 29ft.

When the work of supplying the machinery for the Station was offered for tender, prospective tenderers were given the option of quoting for gas or oil engines. The tender of what was then Gwynne's Engineering Company, Ltd., of Hammersmith, which embodied the use of gas engines made by the Premier Gas Engine Company, Ltd., of Sandiacre, near Nottingham, was accepted. It embraced the supply of the whole of the mechanical equipment of the station, which included a good many accessories beyond the main engines and pumps.

Each of the main engines, which are of the inverted type, has four cylinders, 21in. in diameter by 24in. stroke. The engines operate on the four-cycle principle, and work on town gas which is obtained from the works of the Gas Light and Coke Company at Brentford, a special main, 18in. and 14in. in diameter, having been laid from Hammersmith-broadway to the pumping station, a distance of about 1000 yards, for the purpose. The guaranteed horse-power of each engine when supplied with gas having a calorific value of 415 B.Th.U. per cubic foot—measured on the lower scale—was 480 when running at a speed of 180 revolutions per minute. The guaranteed hourly consumption with the same gas, a temperature of 60 deg. Fah., and a barometric pressure of 30in. of mercury, were 22·0 cubic feet per B.H.P. and 26·8 cubic feet per P.H.P. respectively. As the lift of the pumps must necessarily vary with the levels of the water in the River, and in the suction culvert, it was stipulated that the engines must be so designed that they could be run safely and conveniently at any desired speed between 10 per cent. above and 10 per cent. below the speed necessary to perform the specified duty. The engines are started by means of compressed air, which is obtained in a manner to be described later.

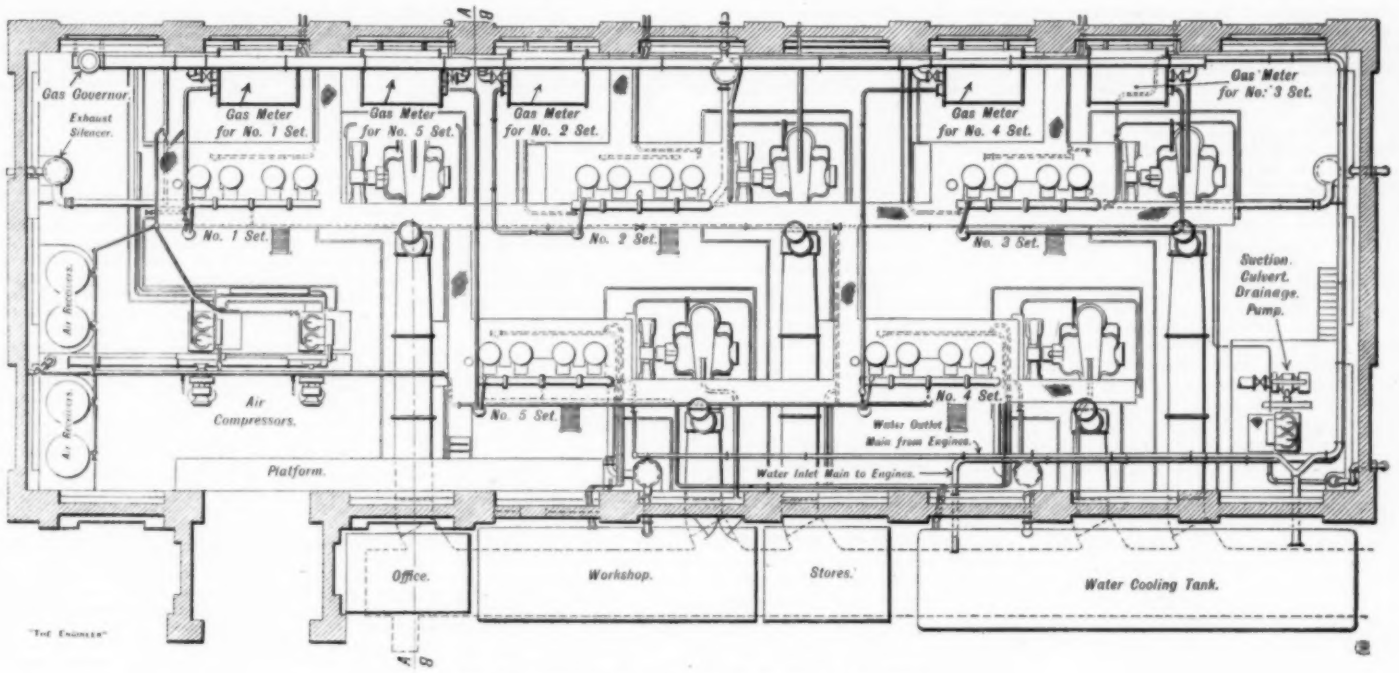


FIG. 3—GENERAL PLAN OF THE PUMPING STATION

There is a separate gas meter for each engine. Each is capable of passing 12,500 cubic feet of gas per hour. The meters are cylindrical in shape, and their cases measure 6ft. 6in. in diameter by 10ft. long. They were made by Messrs. Parkinson and Cowan. When first erected they were connected direct to the inlet valves of the engines through 3in. pipes. It was found, however, that the pulsations in them, which were due to the operation of the engines, were somewhat violent, and it was feared that they might damage the drums. It was therefore determined to connect the gas pipe from each meter to a pipe, 16ft. long and 10in. internal diameter, arranged vertically and closed at both ends by flanges, so as to form a reservoir or receiver of considerable capacity from which the engine might draw its supply of gas. This arrangement was found to act exceedingly well, the pulsations being reduced in intensity to such an extent as to become negligible. The gas pressure is, we understand, guaranteed by the gas company not to fall below that due to 3in. of water, and there is a governor at the inlet end of the gas main, so that the pressure is under control. The main, which runs the full length of one side of the engine-house is 14in. in diameter decreasing in steps as branches are taken off. The gas meters are also arranged in line along the same side of the house as the gas main, as will be seen on the left-hand side in the upper engraving on page 146, which is a view looking along the length of the house from the gallery at one end. The photograph from which this engraving has been reproduced was taken just after the erection of the machinery was completed, but before the gas reservoirs or receivers just referred to were installed. This remark also applies to the companion engraving on the same page. With that exception, the views show the engine-room as it exists. The exhausts from the four cylinders of each engine are taken through an 8in. bore pipe to an exhaust silencer inside the building, and thence to the atmosphere through the walls.

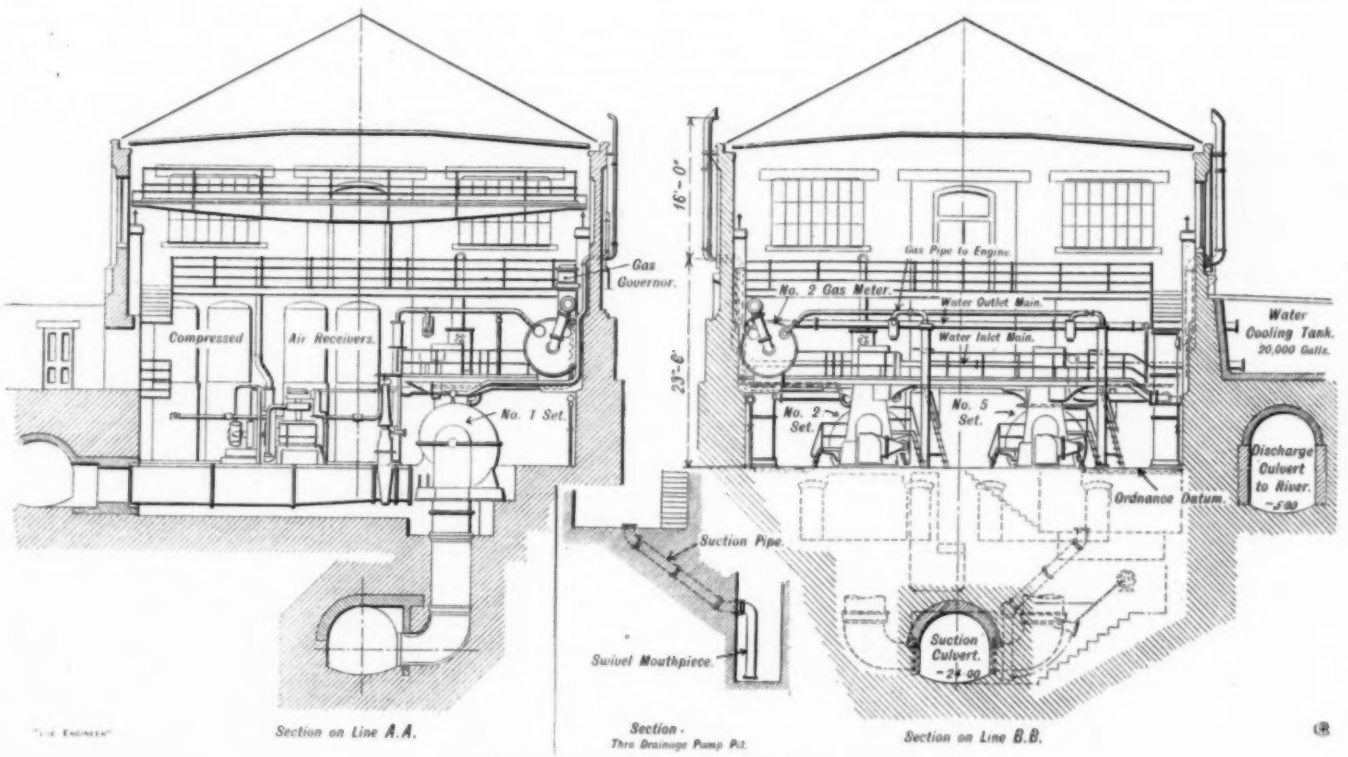


FIG. 4—CROSS SECTIONS OF THE PUMPING STATION

Each engine drives a main pump direct, a heavy fly-wheel with teeth for engagement with a hand barring arrangement being fitted on the crank shaft between engine and pump. The pumps are of Messrs. Gwynnes' manufacture, and were specially designed for the working conditions. The double-inlet impellers are shrouded and corresponding gun-metal

renewable eye rings are fitted on the casings and impellers to take up wear. Other special features, including provision for easy internal inspection and access to the bearings, and of large waterways to avoid obstruction by solid matter, also received special attention. The guaranteed efficiency of these pumps was 82 per cent., which has been realised. The discharge branches are at the bottom of the casing and horizontal, which enables the discharge pipes to be carried in trenches below the engine-house floor. The pumps are designed to be primed by means of ejectors operated by compressed air. The air is compressed in two air compressing sets, each comprising a two-cylinder vertical Premier gas engine, running at 312 revolutions per minute and driving direct a four-cylinder, two-stage, Reavel radial-type compressor. There are four riveted steel air receivers, each measuring some 17ft. high and 5ft. in diameter, arranged side by side, vertically, at one end of the engine-room in the position shown in Fig. 3. It was specified that each of these receivers should have a capacity of at least 320 cubic feet, and it was further specified that each compressor should easily be capable of pumping into one of the receivers sufficient free air to raise the pressure in it from that of the atmosphere to a gauge pressure of 200 lb. per square inch within 25 minutes. The engines have cylinders 11in. diameter by 12in. stroke, and the bores and strokes of the air compressor cylinders are 8in. by 5in. and 10½in. by 5in. respectively.

The air pressure, in addition to the priming for the pumps, is used for—(*a*) starting the main engines and (*b*) driving small air motors for operating the sluice valves of the pumps. There is a 42in. sluice valve in the delivery branch of each pump. Each valve is arranged to be operated either by hand gear, or by means of a small three-cylinder air engine, made by J. Macdonald and Sons, Ltd., of Glasgow. The cylinders of these engines are arranged horizontally and radially. The operating gear of one of the valves is well shown in one of the engravings on page 146 The air motor, which is attached to the valve casing is seen on the right-hand side. It can open the valve fully in a minute and a-half. The two main penstock valves, which have been mentioned as coming at the ends of the suction culvert, have similar operating gear, as also has a further penstock, which will be referred to later.

The air ejectors for priming the pumps are of such capacity that when the water in the suction culvert is standing at a level of 15ft. below the engine-house floor, the time taken to charge the pump does not exceed 5 minutes from the time of the commencement of the operation. It was specified, too, that the ejectors must be capable of charging five pump cases within 30 minutes—and any less number within a proportionate time—two of the receivers only being in use, and the compressors not working. As a matter of fact, we understand that the five pumps can actually be charged and five engines started up in less than 20 minutes.

The cylinder cooling water is contained in a concrete tank formed in the engine-house immediately over the discharge culvert in the position shown in Figs. 3 and 4. It is 49ft. 6in. long by 11ft. 3in. wide, and it contains water to a depth of 6ft., its capacity being some 20,000 gallons. The water is forced through the cylinder jackets and covers, and also through jackets arranged around the exhaust pipes by means of small centrifugal pumps, one of which is driven from each of the main engines by a chain enclosed in a casing. The water is drawn from and delivered into common mains, the suction pipe being arranged at the bottom at one end of the tank, and the warm water being discharged again into the tank near top water level at the other end. The level of the water in the tank is maintained constant by means of water from the supply mains through a ball cock, though, of course, but little make-up of water is required.

As will be evident from the drawings, the main pumps are not capable of entirely emptying the suction culvert, and in order to ensure that it may be emptied, should that operation become necessary, a small drainage set, the position of which is to be seen at the right-hand bottom corner of Fig. 3, has been provided. It consists of a two-cylinder vertical Premier gas engine exactly similar to those previously described for driving the air compressors, coupled direct to a Gwynne horizontal-spindle centrifugal pump, the speed of the combined set being 300 revolutions per minute. The pump, which has 12in. diameter suction and delivery branches, and has a sluice valve on the delivery side, is designed to lift 12 tons of water per minute against a maximum head of 42ft. from all causes. The suction nozzle of this pumping set is made to swivel and can be lifted well above the lowest part of the culvert by means of a chain and winch. This provision was made so as to prevent the nozzle from becoming clogged with silt and dirt, so that when pumping begins it may draw comparatively clear water. When allowed to hang vertically, however, as seen in Fig. 4, the nozzle practically reaches to the bottom of the culvert, so that it can pump out all but a very small quantity of water.

The discharge culvert to the River, where it comes beside the engine-house, is of the form shown in Fig. 4. It measures 10ft. 6in. high by 7ft. 6in. wide, both its invert and its roof being curved. Its invert is at 5ft. below Ordnance Datum. Just outside the engine-house it enters a chamber, which also receives, at right angles, a connecting culvert coming from the penstock chamber B—see Fig. 2. This culvert is controlled by penstock C, and if the latter were opened it would be possible to pass storm water direct from the 8ft. storm Relief Sewer into the River through the Discharge Culvert, thus by-passing the pumping station, providing the state of the tide permitted it. As a matter of fact, we understand that, before the pumping Station was completed, storm water was actually sent through this channel when conditions suited.

Beyond the connecting culvert penstock chamber the discharge culvert becomes circular, 9ft. 6in. diameter, and continues of that form for some 600ft., when it enters an inspection chamber formed under a wharf on the river side. Access to this inspection chamber is obtained through a manhole at wharf level. The invert of the culvert where it joins this chamber is — 3·0 O.D., and the floor of the chamber is at — 4·0 O.D. It will be noticed that these levels at 2ft. and 1ft. respectively above the level of the invert of the discharge culverts in the engine-room. The reason for this is that, in order to clear existing pipes, it was necessary to raise the discharge culvert just outside the engine-house. As a matter of fact, the invert at its highest point reaches Ordnance Datum. The culvert is protected from inflow from the river by means of four non-return flap valves arranged on the circular outlet.

From the inspection chamber the discharge into the river is through two cast iron pipes 6ft. 6in. in diameter, the inverts at the discharge end being 14ft. below Ordnance Datum. At the point of discharge the level of ordinary high water in the River is 12·5ft. above O.D., ordinary low water level coming at 3·0ft. below O.D. The discharge is, therefore, always well below water level.

The Station has been brought into operation on many occasions since it was put into service, and has performed its duties excellently. Ordinarily, the water level is allowed to stand at about 19·5ft. below O.D. Watch is kept at the Station continuously night and day. When rain threatens, preparations are made to start as many of the pumping sets as may be necessary. When rain starts, one or more sets are started to work slowly. As soon as the level of the water rises above the ordinary standing level, as shown by float-operated indicators which can be seen from all parts of the engine-house, one set is got fully to work, and if the level still rises, other sets are cut in, and so on till the rise is checked. So far, we believe, the full equipment has not had to be used at once, but in the near future further sewers are to be connected up to the relief system, and then greater demands on the pumping capacity of the plant will be made.

The whole scheme has been exceedingly well designed and carried out, and it reflects great credit on designers and contractors alike. All the works, we may explain, were designed and their construction supervised by the Main Drainage Division of the Department of the Chief Engineer of the Council. Our thanks are due, not only to Sir G. W. Humphreys himself for permission to publish this description and for affording us facilities for visiting the station and doing so, but also to various members of his staff for courteous assistance in the preparation of this article.

In conclusion, we may add that the approximate cost of the pumping station and of the sewers and other works connected with it was £300,000.

First-Aid and Rescue Work in Mines.

The Seventh International First-aid and Mine Rescue Contest is to be held at Butte, Montana, from August 20th to 22nd, under the auspices of the United States Bureau of Mines, Department of Commerce. These International First-aid and Mine Rescue Contests are held each year under the auspices of the Bureau of Mines, with the co-operation of the National Safety Council, the American Red Cross, and various mine operators' associations and miners' organisations. Expert first-aid and mine rescue teams from the important mining districts of the country compete at these events for a large number of prizes and trophies given by different mining or safety organisations.

Each first-aid team is required to perform certain definite problems in first-aid practice, calling for the treatment of injuries and proper handling of a "patient." The mine rescue teams, provided with oxygen breathing apparatus and other necessary equipment used by rescue crews in coal and metal mines, work out practical problems, such as are likely to be encountered in underground rescue and fire-fighting operations. Employees of coal and metal mines, quarries and metallurgical plants and workers in the oil and gas industries are eligible to participate in the contest, so that more than 2,000,000 workers, living in practically every State and Territory, are interested.

Since the creation of the United States Bureau of Mines in 1910 approximately a quarter of a million miners have been trained by the Bureau in the technique of mine rescue work and in the art of administering first aid to the injured. The large growth of this work is evidenced by the fact that during the past fiscal year 48,604 miners were given this training. An interesting development of this movement is the co-operation arranged with many of the largest mining companies in the United States, under which every employee of the company is instructed in the methods of saving life underground. In the past fiscal year 15,922 miners were trained under this intensive system.

Not only have the miners been instructed in first-aid measures, but their wives, sons, daughters and neighbours have also been trained in the art, so that they, too, may lend a helping hand in time of need. The entire membership of certain grades in the schools of various mining towns have taken the first-aid training. The *personnel* of the police and fire departments of many cities have taken the training, as have the employees of telephone companies, gas and electric companies, and other public utilities.

An international aspect will be given to this year's contest by the fact that mine rescue teams from large Canadian mining companies are expected to participate in the competition. It is anticipated, also, that prominent officials of the Canadian mining department will attend. The governors of numerous important mining states have designated representatives to be present at the contest.

Various prizes will be awarded those teams which, in the opinion of the judges, prove most efficient. Each first-aid team will be composed of six men, including a "patient." Each team will be required to perform nine or more definite problems in first aid, calling for the treatment of injuries and the proper handling of the patient. The patient, assumed to be suffering from electrical shock, arterial bleeding, broken bones, or other injury, will be given the first-aid treatment prescribed in the manual of the Bureau of Mines. The events will be judged by doctors and expert laymen skilled in first-aid training and conversant with the Bureau of Mines first-aid standards.

The competing mine rescue teams will be composed of five men provided with oxygen breathing apparatus and other necessary equipment used by rescue crews in coal and metal mines. The teams will be required to work out a specially prepared, but practical, problem such as is likely to be encountered in underground rescue operations.

A feature of the meeting will be the awarding of the Congressional medal, which is given annually to the team of miners adjudged most thoroughly skilled in first-aid and mine rescue methods, and the assigning of various cups and trophies to winning teams from certain specified districts. The first-aid teams which will compete in the international contest represent the winning teams from contests held at different places in various parts of the country. Approximately 300 teams participated in these local and inter-company contests, and the winners were selected to be sent to the international contest.

The event held annually at Butte, known as "Miners' Field Day," which is expected largely to swell the attendance at the meeting, is an institution almost unique in the annals of mining. At the meeting there are held races of various descriptions, such as potato races, egg-spoon races, sack races and wheelbarrow races. The women of the community participate in nail-driving contests and 100-yard sprints. Boxing, wrestling and baseball are indulged in. A "mucking contest" is usually held, in which a great quantity of ore is shovelled from a smooth platform into an ordinary ore car. Ladder climbing and rock drilling contests are also staged by the miners.

Butte, where these meetings take place, claims to have produced more copper than any other district in the world. The famous Butte hill is pierced with more than a hundred shafts, some of them 3600ft. deep, from which about 10,000 miners hoist approximately 20,000 tons of copper and zinc ores to the surface every twenty-four hours. The underground workings total over 2700 miles. In round figures the maximum annual production, in terms of finished metal, is 300,000,000 lb. of copper, 150,000,000 lb. of zinc, 12,000,000 oz. of silver, and 60,000 oz. of gold.

SIXTY YEARS AGO.

For fifteen years onwards from 1853 Baron Hausman, Prefect of the Seine, laboured, under the encouragement of the Emperor Napoleon, to rebuild and improve Paris. By 1870, it was planned, all the works were to be completed. Writing in our issue of August 7th, 1868, we summarised the statistical portion of a report which the Baron had submitted to the Emperor on the position reached with the works down to the end of 1867. We pointed out that the expenditure on the improvements amounted to one-tenth of the national debt of Great Britain. Since 1853, 56 million pounds had been expended on the construction of new streets and roads, principally in that portion of the city situated within the old barriers, on the erection of churches, schools, hospitals and markets, and on other improvements. In addition, an expenditure of nearly 19 million pounds remained to be met in connection with works still in progress. Those works included an improved water supply and an improvement in the city's sewerage system. In 1853 the water supply of Paris was derived principally from the Ourcq Canal. It amounted nominally to about 25 million gallons per twenty-four hours, but because of the smallness of the pipes not more than 75 per cent. of this quantity was ever delivered. Baron Hausman's improvements raised the total supply to 77 million gallons, chiefly by pumping from the Seine and by the construction of new waterworks on the rivers Marne and Dhuis. In addition to these new sources of supply the improvements included the laying of about 480 miles of pipes varying from 15in. to 42in. in diameter. In 1852 the total length of the sewers in Paris was about 67 miles. Under the Baron's scheme of improvement 107 miles of new sewers were constructed and the sewage was discharged into the Seine at Asnières and St. Denis. In addition a large number of the old sewers were reconstructed and enlarged. The financial arrangements made to meet the cost of all this work involved drawing on the resources of the future for the succeeding sixty years and were, in our view, open to severe criticism. The same system had been adopted in connection with the completion of the French railway system and the construction of other works of public utility. No tax was, by the Emperor's express wish, to be levied on the inhabitants of Paris to meet the costs of the improvements. The charges were to be paid out of the ordinary revenue of the city or by loans received from the Crédit Foncier Company.

It is claimed that the hydraulic fill dam to be built at Cobble Mountain, Massachusetts, will be one of the largest of its kind. It will be 245ft. high and will contain 1,800,000 cubic yards of material.

Railway Matters.

GOLFERS and other visitors to Turnberry on the Ayrshire Coast will benefit by the happy idea that has occurred to the London, Midland and Scottish officials to send the Euston–Stranraer sleeping car forward to Girvan and Turnberry after it has deposited its Larne boat passengers at Stranraer. The car, at night, will commence its return journey at Turnberry, call at Girvan, and then await the arrival of the boat from Larne at Stranraer.

A GOOD dozen or more years ago the North British Railway Company installed at its St. Margaret's carriage sheds, Edinburgh, a carriage-washing plant. Its success has now led to the London and North-Eastern ordering electrically operated plant to be fixed at Ilford, York, and Cowlairs, which will consist of a series of vertical drums with brushes so fitted on both sides of the track that they rotate at high speeds and thoroughly wash and spray complete trains as they are shunted through.

THE trains on the elevated railways of New York City run so close after each other that it has not been found possible to protect them, except at sharp curves, by signals. Knowing the danger of that system of working, the motormen exercise great care, and it is very rarely that a collision occurs. There was, however, a collision on the evening of Sunday, July 29th, at Sixty-Ninth-street and Columbus-avenue, when many passengers riding on the platforms between the cars were seriously hurt, and many more injured in the subsequent panic and struggle to get out.

BAVARIA would appear to be suffering, as were British railways in 1905, 1906, and 1915, from an unexplainable wave of railway accidents. On June 10th a derailment caused the death of twenty-four persons, and on July 18th there was a collision which led to ten deaths. Then, on July 31st, a passenger train was turned into a siding between Ulm and Augsburg, and collided with a goods train. Fourteen lives were lost on that occasion. Public opinion in Bavaria is very concerned over these disasters, and led, no doubt quite erroneously, to ascribe them to the lines being worked as part of the German Railways Union, and not, as prior to 1924, by the Bavarian Government.

THE following letter from Mr. C. W. Galloway, vice-president of the Baltimore and Ohio Railroad Company, has been received by the G.W.R.: "It might interest you to know that we have just finished a locomotive with water-tube back end, eliminating entirely staybolts. This engine was designed by Colonel George H. Emerson, our chief of motive power and equipment, and was built at our Mount Clare shops, Baltimore. We have copied the front end from the 'King George V.,' and we endeavoured to copy the stack, but do not believe we got that quite right in the shape of the copper top. You will also note that we have endeavoured to eliminate all the trimmings usually found on the exterior of an American locomotive, and with the exception of the two air tanks for the automatic brakes, we have concealed everything. The air pump is between the frame opposite the centre of the two back drivers." This is interesting evidence of the growing desire of American railways to improve the appearance of their engines.

IN the early hours of January 25th last a Great Western goods train came to a stand, owing to engine failure, on Cefn Viaduct, between Chirk and Ruabon. Later, the signalman at Black Park, the box in the rear, wanted to send a second goods train, but as the first had not been cleared on the block instrument, he asked the man at Llangollen Junction if it had passed. The man at the latter box assumed that it had, and, without looking at his train register book, he forthwith gave the train-out-of-section block signal for the first train and accepted the second. In the resultant collision five of the six trainmen were hurt, there was considerable damage to rolling stock —partly from a fire which broke out in the guard's van of the standing train—and a very narrow escape of some portions of the two trains falling over the viaduct into the valley of the Dee, 120ft. below. The standing train was not protected by the guard going back in accordance with the rules, as that man had first to go to the engine to see what was amiss. Having arranged with the driver that he should first protect the train and then go back to Black Park box to obtain assistance, the guard returned to his van for detonators and was about to again alight when the collision occurred. Colonel Trench inquired into the accident, and in his report, after censuring the signalman at the box in advance, says that the circumstances point to the necessity for a code of whistle or lamp signals between drivers and guards to ensure that the latter must forthwith protect the train.

THE interim dividends announced the other day gave a pleasant surprise to those interested therein, as they were not as much below those of a year ago as was expected. A gratifying new departure made by the London, Midland and Scottish and the London and North-Eastern was a full statement as to the result of the half-year's work. Whilst the former company dropped its interim dividend from 2 per cent. a year ago to 1¼ per cent., as a consequence of a fall of £2,100,000 in the receipts, it shows that but for economies to the amount of £1,000,000 the situation would have been serious. The London and North-Eastern had a decrease of £1,500,000, of which £344,000 was due to the falling off in passenger traffic. Actually, the latter was not as bad as it looks, as passenger journeys decreased by only 2·4 per cent.; owing to reduced fares, the passenger receipts fell by 4 per cent. The L.N.E.R. statement says that cheaper fares and increased facilities are the only means by which passenger revenue can be re-established in face of road transport. As the Great Western a year ago paid ¾ per cent. more than the L.M.S., and only pays ¼ per cent. more now, it would seem that its economies had not been as effective. The Great Western issued no statement similar to that of the northern companies. The Southern Railway had the satisfaction of having had an increase—of £50,000—in its passenger traffic. That mainly was due to the extra day of leap year, but it was the only company to report an increase in passengers. It lost, on the other hand, £320,000 in goods traffic. The resultant loss of revenue was, however, offset by economies, especially in fuel. The Metropolitan pays 1¼ per cent., as compared with 1 per cent. a year ago.

Notes and Memoranda.

IT is claimed that a new record in shaft sinking was made in the No. 4 vertical shaft of th Springs Mines, Transvaal, when the footage was advanced at the average rate of 9·68ft. per day. The shaft is 31ft. by 13ft. in section, and the drilling was done by seven Lyner-Ingersoll machines using Bedford's drill steel.

THE description, in the *Engineering News-Record*, of the construction of a lighthouse in Lake Huron is reminiscent of the "Mystery Towers" of Shoreham. The lighthouse is a steel and concrete structure founded in a depth of about 6ft. of water, 8 miles off shore. The base, about 64ft. square, was floated out into position, and on it a tower 70ft. high was built. The cost of the structure was some £20,000.

DURING a blizzard in Michigan early this year, overhead wires were heavily loaded with accumulated ice, but although none of the wires were brought down through this cause directly, some of them failed through being broken by falling trees. In one case a wire of No. 13 gauge accumulated a mass of solid ice, 1in. in diameter, which, together with depending icicles represented a load of 70 lb. per 100ft. length.

THE carbonising plant of the Ackworth, Featherstone, Purston and Sharlston Gas Company at Featherstone is to be closed down, and a bulk supply of gas will be obtained from the coke ovens of the neighbouring colliery at Ackton Hall. Hitherto all the gas has been made in the usual way by the company's own plant. The only connection necessary has been the laying of about 1080 yards of 6in. main from the colliery to the gasworks.

FOR the purposes of conveying materials for the construction of the Diabolo Dam, in Washington, an incline has been made which is capable of raising standard railway rolling stock through a vertical distance of 313ft. The incline has a length of 563ft., and carries a transfer platform 60ft. long on two pairs of rails. The gross load may be as much as 70 tons, and is counterweighted to the extent of 45 tons. The hoist is operated by a 400 horse-power alternating-current motor.

IT has been found at the Marston Lake filter plant of the Denver waterworks, that sodium aluminate and alum are better for coagulation than lime and alum. Their use results in lower turbidity in the filtered water, greater removal of bacteria and micro-organisms, and a decrease in the amount of wash water required. It has been found that mud ball formation is inhibited by this type of coagulation. Operating costs have not been increased, while the efficiency of plant operation has been greatly helped.

EXPERIMENTS conducted at the Bell Telephone Laboratories in New York City by Drs. C. J. Davisson and L. H. Germer show that electrons are reflected from a crystal of nickel in certain definite directions, much like X-rays. The scattering of X-rays in certain directions has always been explained on the hypothesis that these rays are an electro-magnetic wave disturbance of the same sort as radio waves and visible light. The experiments with a beam of electrons show the same effects. The inference drawn by Dr. Davisson is that there is some sort of a wave motion associated with the motion of a beam of electrons.

LAST week, says the *Engineering News-Record* of July 26th, a group of business men met to consider what could be done about abatement of construction noises, and decided to draft, for presentation to the municipal authorities, an ordinance that would limit the nuisance by punitive provisions. Among other things, these men cited the serious interference with telephone communication which construction noises cause; the nervous annoyance, and, where windows are closed to muffle the noise, the resulting bad effect on health. They listed the unmuffled power shovel, the pile driver, the rivet hammer and steam machines with loose packing-boxes as the chief culprits. Their complaint is entitled to attention.

ACCORDING to Sir Henry Miers, the inefficiency of the majority of local museums arises from three sources. In the first place, it may be embedded in their history, for many begin as odd and nondescript collections made by "collectors," and many have continued the tradition of their foundation. In the second place, it may arise from indefiniteness of ideas as to the purposes and capabilities of museums in general or of some particular museum. This weakness is especially centred in governing or controlling bodies which, with the best will in the world, may be able to give no useful guidance in the development of the collections of which they are trustees, and at the worst may regard the museum as a home for derelicts, requiring no attention, demanding no progress, a place set aside for moths and dust. The last inefficiency lies in the museum curator himself, who, through lack of knowledge, lack of training, or lack of ideas, may be unable to guide either his collections or his trustees.

DURING the past fifteen years the United States Bureau of Mines, Washington, D.C., at its experimental mine near Pittsburg, Pa., has tested mine-sized dust prepared from coal taken from twenty-nine different mines in different parts of the country. These range in composition from the anthracites of Eastern Pennsylvania to the high volatile coals of Utah and Wyoming. The amount of incombustible material required in a mixture to prevent propagation of an explosion under standard propagation test conditions was determined for each coal. It was found that 20 per cent. was sufficient for a coal whose ratio of volatile to total combustible was 0·15, but the quantity increased rapidly with increasing ratio and 61 per cent. was required with coals whose ratio was 0·23. There was then no further increase until ratio 0·40 was passed; that is a coal having a ratio of 0·40 required 61 per cent. incombustible in the mixture, the same as a coal of ratio 0·23. Beyond ratio 0·40 there was a slow increase and 70 per cent. incombustible was required for coals whose ratio was 0·50. It is felt that these limits are known with sufficient accuracy to justify applying them to any coal not tested in the experimental mine. Composition is one of six factors which influence the explosibility of coal dust and a paper summarising the present knowledge of all six is in preparation for publication by the Bureau

Miscellanea.

THE average production per man in blast-furnaces in the United States increased from 25 tons in 1850 to 1257 tons in 1925. The increase has been almost continuous except for the years immediately affected by war conditions. During the period from 1850 to 1925 the number of employees in the blast-furnace industry increased only 44 per cent., while the output increased more than 7000 per cent.

GLASGOW Corporation Special Committee on the Reorganisation of the Electricity Department, at a recent meeting, recommended that the new manager, Mr. Herbert Bell (Hull), although he is over age for participation in the Corporation's superannuation scheme, be accorded by the department the same benefits as he would receive if he came under that scheme. It was explained that Mr. Bell was willing to transfer to Glasgow Corporation his deposit in the Hull scheme if he were put on the superannuation basis.

H.M. TRADE COMMISSIONER in East Africa reports that the numbers of motor vehicles in use at the end of 1927 in Kenya Colony were 4488 motor cars and 636 motor lorries and tractors, and in Nyasaland 457 motor cars and 306 motor lorries. He further reports that there were 523 motor cars in use in Zanzibar, but that statistics of the number of motor lorries in use are not available; that there were 915 motor cars and 945 motor lorries in use in Tanganyika, 472 motor cars and 175 motor lorries in use in Northern Rhodesia, and 935 motor cars and 951 motor lorries in use in Uganda at the end of last year.

AT a recent meeting of the Lincoln City Council, the chairman of the Electricity Committee said that the electricity output had increased by 2,308,912 units, mainly for power purposes. The revenue, on the other hand, was £10,153 less than in the preceding year, which followed the operation of the coal clause in the big consumers' agreements. The working expenditure largely for the same reason, i.e., lower coal cost, was down by £15,276. The gross profit was £48,628, and the net surplus £4732, to go to reserve and depreciation account. It is proposed that the cost of Canwick-road sub-station—£2800—shall be met out of this account, rather than by loan. The average price received for private supplies was 3·934d.

THE Colonial Government of the Belgian Congo has recently approved a decree setting up regulations regarding the supply of electricity in the colony. They stipulate (1) that for private lighting installations only 110-V direct current or alternating current shall be used; (2) for public lighting or for both public and private power distribution systems, only three-phase four-wire current at 220/390 volts is permitted; (3) for power reserved for traction or private or public power purposes, direct current or three-phase at 550 volts may be used; and (4) power may be distributed in bulk as alternating current at 2200, 6600, 10,000, 15,000, 55,000 or 110,000 volts. In the case of alternating current, a frequency of 50 periods per second is to be standardised.

THE State Government of Tucuman, one of the wealthier provinces of Argentina, with important sugar mills and distilleries, has agreed with the neighbouring provinces of Salta, Catamarca, and Santiago-del-Estero to construct an extensive system of roads. To meet the heavy cost, all four States will make substantial appropriations. The Federal Government has also consented to provide special railway quotas to pay for new roads leading to railway stations. Public tenders will be invited for the works. It is possible, however, that the respective municipalities will undertake the work on their own account, in which case a large amount of road-building machinery and implements would be required. Representatives of several United States road machinery companies are already established in Argentina, and keep in close touch with the authorities. British road machinery manufacturers are inadequately represented.

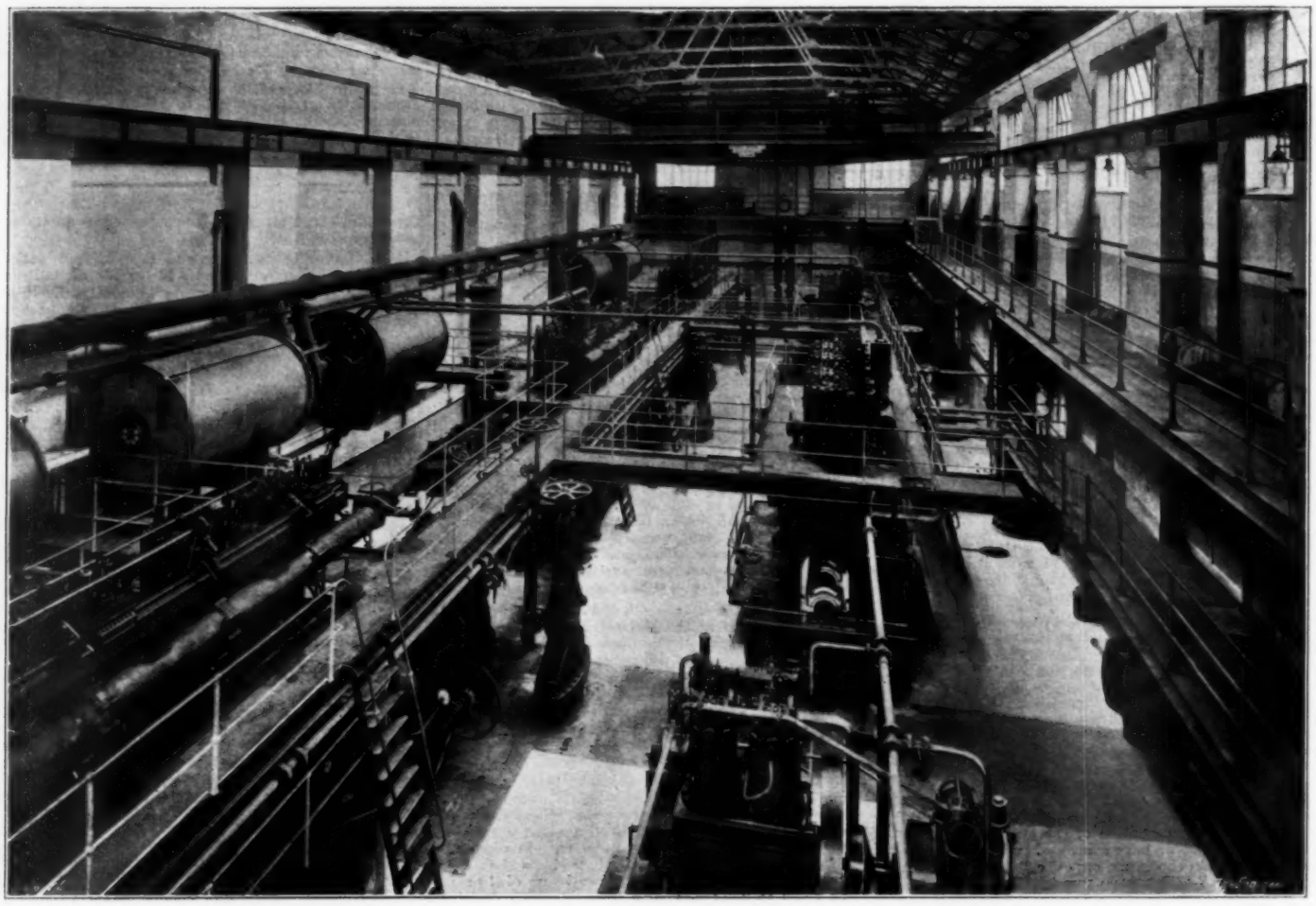
THE Peruvian Government has approved the final plans for a supplementary potable water supply and drainage system for the newly built parts of Lima. The cost is estimated at £P100,000. A sum of £P40,000 has been allotted for the extension of the filtration galleries at La Atarjea, and larger mains will be laid in Lima and the various suburbs. On the supply of new piping £P20,000 will be spent. The Lima water comes from the Menacho reservoir, 3 kiloms. from the town. Although of excellent quality on the whole, it has recently become contaminated through the condition of the old mains. This defect will now be removed, and the supply will be increased from 50,000,000 litres to between 80,000,000 and 100,000,000 litres daily, enough for a population of 300,000. A contract will also be placed for paving new streets with asphalt, at the estimated cost of £P85,000, and similar contracts, estimated to cost £P40,000, will bring the total expenditure to £P225,000. The work will be carried out by an American company which has executed a considerable amount of sanitation work in different Peruvian towns.

FAR-REACHING changes in the management of Australian broadcasting, states the *Wireless World*, will probably occur next year, when practically all the existing broadcasting licences will have expired. Mr. Bruce, the Australian Prime Minister, has announced the Government's new policy arising out of the widespread complaints regarding the quality of programmes sent out by the existing "A" class stations, which, to all intents and purposes, are controlled by a combine covering the entire Commonwealth. The Government contemplates taking over the plant and equipment of all privately owned "A" class stations, with the object of placing the complete programme and news arrangements in the hands of private contractors who will be invited to submit tenders. General supervision of the service will be vested with the Postmaster-General, who will be empowered to ensure the maintenance of the standard of programmes by withholding part of the licence fees payable or by cancelling the contract. The contractors will be paid a percentage on each licence fee. An advisory committee will assist the Postmaster-General in all questions requiring technical consideration and in the supervision of programmes. Research work will be financed from the balance of licence fees after the contractors have been paid.

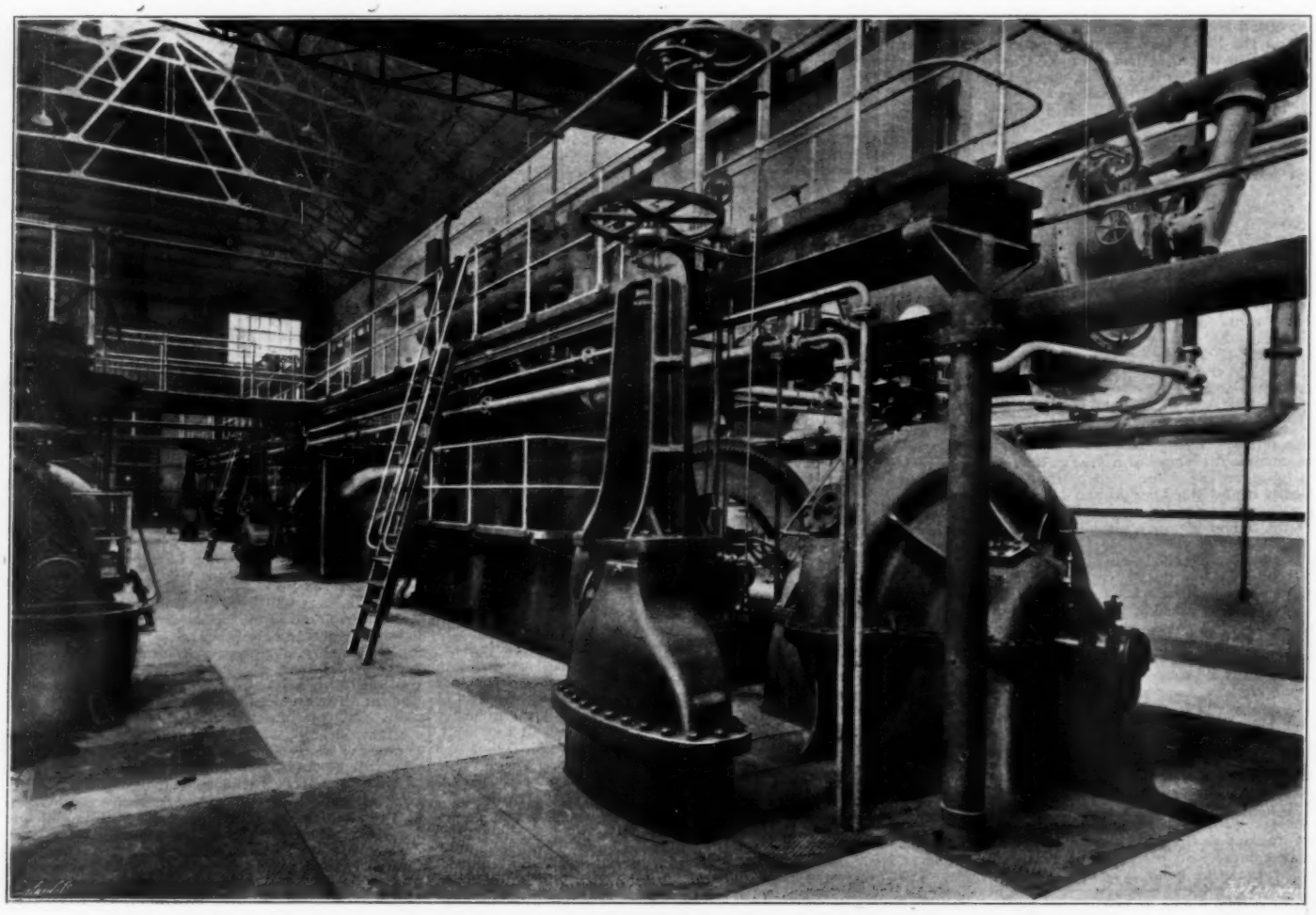
HAMMERSMITH STORM WATER PUMPING STATION

SIR G. W. HUMPHREYS, M. Inst. C.E., LONDON, ENGINEER

(*For description see page* 142)



General View Showing Gas Meters on Left-hand Side, with Air Compressor in Foreground



View of Pumping Set Showing Pump Sluice Valve Operating Mechanism

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TWO-PAGE SUPPLEMENT—SOME RECENT CANADIAN HYDRO-ELECTRIC POWER PLANTS.

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THE ENGINEER.

AUGUST 10, 1928.

Ocean Liners.

WORK has been begun on the new Atlantic liner which the White Star Company ordered recently from Harland and Wolff, of Belfast. This vessel, the impending construction of which was foreshadowed in THE ENGINEER several months ago, will have a tonnage greater than that of any existing ship. Although her exact dimensions have not yet been disclosed, it is known that her gross tonnage will be at least 60,000 and her length about 1000ft. The "Majestic," the largest ship now afloat, is of 56,551 tons gross, and has a length of 956ft. over all. Her displacement, which is generally accepted as a truer indication of size than gross tonnage, is 64,000 tons, as compared with the 63,060 tons of the "Leviathan," which is often advertised by her owners, the United States Shipping Board, as "the largest ship in the world." The point as to which is the larger ship is not, however, really in dispute, since the designer of both vessels, Herr Foerster, of the Blohm and Voss firm, has publicly stated that two extra frames were worked into the "Majestic" amidships in order to make her the greatest ship ever built.

It will be observed that the new White Star liner now on the stocks at Belfast is classified, not as a "super-Majestic," but as a "super-Olympic." This appears to indicate that her general design has been developed out of the British-built prototype rather than from the German vessel. There can be no question as to the soundness of this policy. While we yield to none in appreciation of the work of German shipbuilders, we are nevertheless convinced that British ships, taken as a whole, are superior to all others in both design and construction. Nor is this mere national prejudice. Apart from the high standard of workmanship which is so characteristic of our leading shipyards, British ships embody a fund of experience which is the unique possession of our naval architects and builders. This applies to every class of vessel, but particularly to the ocean liner, the special functions of which confront the designer with many difficulties. The most essential features of such a vessel are safety, comfort, and absolute reliability in the engine-room. Safety demands the most meticulous calculations as to stability and seaworthiness, combined with maximum strength of structure. The element of risk must be reduced to vanishing point, "safety first" being the guiding principle of passenger ship construction. When a very high speed is specified the problem becomes still more complicated, since a form of hull suitable for great speed may lack those qualities of steadiness and dryness which are regarded as indispensable in a liner. This problem, however, was satisfactorily solved as long ago as 1906, when the "Mauretania" and the "Lusitania" were built. In these magnificent ships high speed was combined with excellent sea-going qualities. Although nearly a quarter of a century has passed since her plans were drafted, and twenty-one years have elapsed since she sailed on her maiden voyage, the "Mauretania" is still in regular service. The annals of steam navigation afford no parallel to the career of this grand old veteran, which has recently astounded the world by setting up a new record for the Transatlantic crossing. She arrived at New York from Cherbourg at 4.26 p.m. on July 19th, having made the passage in five days three hours seventeen minutes, thus beating her previous world's record, made in August 1924, by three minutes. Moreover, on her latest passage she twice eclipsed her own record for the best day's steaming on this route, covering 654 miles from noon Monday to noon Tuesday, and 663 miles in the succeeding twenty-four hours, at average speeds of 26·16 and 26·46 knots respectively. We venture to say that, had any foreign ship accomplished such a feat, all the resources of publicity would have been employed to broadcast the fact throughout the world. As it is, however, the exploits of the "Mauretania" cannot fail to enhance the prestige of British shipbuilding and marine engineering. It would appear that no decision has yet been reached in regard to the type of propelling machinery for the new White Star vessel. As Lord Kylsant, the chairman of the company, has great faith in the internal combustion engine, and as Harland and Wolff the builders of the new vessel, have already constructed several of the largest and most successful motor liners, it has been widely assumed that oil engines will be installed in the "super-Olympic." We have, however, reason for believing that steam turbines will be selected. If the new ship is to be as fast as the 25-knot "Majestic"—and it is doubtful whether the company would accept a lower speed—her machinery must develop at least 70,000 H.P. The largest set of marine oil engines so far built has, we understand, a capacity of 25,000 B.H.P. To construct a plant of almost thrice this capacity would therefore be a very formidable undertaking, and one on which the most enterprising shipowner might well hesitate to embark. Not only would the first cost greatly exceed that of turbine machinery of corresponding power, but the building of an oil engine plant of such magnitude would be, in effect, a bold, not to say hazardous, experiment, which the White Star management may decide against as being inadmissible in the circumstances. It should not be forgotten that the same company has already under construction at Belfast a motor liner of some 26,000 tons, which is therefore the largest British motor ship laid down up to the present. The performances of this vessel in service will doubtless influence the policy of the company with regard to the machinery equipment of its future vessels. Certain commentators have taken it for granted that the 60,000-ton leviathan will not be particularly fast, because hitherto the White Star Line has built ships more remarkable for comfort than for speed. But, since the two qualities are not incompatible, the "super-Olympic" may prove, perhaps, to be speedier than any vessel now afloat or under construction, not excepting the two Norddeutscher-Lloyd vessels, which are designed for 26½ knots. Meanwhile the Cunard Company is understood to have ready the plans of a ship which will be in all respects a worthy successor to the "Mauretania." In this case very high speed is rumoured to be an outstanding feature of the design. Alike for reasons of sentiment and business, we trust that these two great British liner companies may put afloat, in the not too distant future, vessels which will ensure the retention by this country of the blue riband of the ocean, while upholding the traditions of safety, comfort, and reliability to which British liners owe their marked popularity with the travelling public. The pre-eminence of Great Britain in this branch of shipping is revealed by the new volumes of Lloyd's Register, which show that 57·7 per cent. of the existing liner fleet—*i.e.*, vessels of 15,000 tons and upwards—is British owned.

Regarded purely as a commercial proposition,

it may be doubted whether the huge liner of great speed is a complete success. According to an unofficial estimate, the "super-Olympic" will cost about £5,000,000 to build and equip. The cost of operating her will depend mainly on her sea speed. Every additional knot, nay, every additional fraction of a knot, means a disproportionate increase in the fuel consumption. We have no means of estimating the fuel bill of a 60,000-ton ship on a passage from Southampton to New York at a speed of, say, 28 knots, but at the current price of bunker oil the figure would certainly be a formidable one. When to this heavy item is added the cost of victualling the ship on the lavish and luxurious scale now demanded by the Transatlantic passenger, salaries and wages, port and harbour dues, and numerous other charges inseparable from the operation of a big liner, we imagine that the margin of profit left over, even with a full passenger list, would be very narrow indeed. It has, in fact, been often stated, and never denied, that our largest liners are actually run at a loss. Without being able to verify this we are none the less convinced that the ordering of such vessels as the "super-Olympic" is not directly inspired by the hope of earning dividends. On the other hand, indirect benefit accrues to a company which has the distinction of owning ships of world-wide repute, so that the possession of these costly vessels may bring other and more lucrative business to the owners. When the fleets of our principal liner companies are examined they will be found to comprise, in the main, vessels of moderate speed which are comparatively economical to run and which probably earn a substantial profit on each voyage with a normal quota of passengers and cargo. It is to vessels of this class, rather than to the high-speed liner, that our great shipowning firms look for their dividends. At the same time, while there is commonly supposed to be no room for patriotism in business, we do not doubt that the desire to maintain the supremacy of the British merchant navy is responsible, in some measure, for the building of a ship such as the "super-Olympic," the construction of which it might be difficult to justify on the grounds of business alone.

Rural Electrification.

If the electrification of the rural parts of Great Britain does not prove a general success, its failure to do so will not be attributable to lack of enthusiasm on the part of its supporters or to want of thought and investigation. Although politicians have promised to place cheap electricity at the disposal of everyone, engineers have always recognised that the supply of current to sparsely populated areas is not devoid of difficulties. Early in 1927 the matter was taken in hand by the Electricity Commissioners, who, later in the year, proceeded to convene a conference with a view to co-ordinating the results of prior and concurrent investigations and of obtaining such information as was necessary for a general survey of the subject. Two sub-committees were formed, one to investigate and report on the nature and extent of the potential demand; the other to report on the bearing and general effect upon rural development of the price of supply and the cost of electrical equipment. The question of publicity and propaganda was remitted to the British Electrical Development Association for consideration and report after consultation with certain representative bodies. A recently published report of the proceedings of the conference, together with the findings of the sub-committees, indicates that the electrification of the rural parts of Great Britain would not be such a profitable undertaking as some seem to imagine. Many rural areas, the report states, are so sparsely populated that electricity supply is not at present justifiable; in fact, it appears that some places are not likely to get a supply at all. It is evident, the investigators say, that for economic reasons rural electrification cannot be proceeded with to the extent of placing a supply of electricity at the service of every inhabitant, farm and other premises throughout rural Britain. The prospects in the most sparsely inhabited and most remote areas are of such a low order as to preclude, or at any rate delay for many years to come, the establishment of a public supply on a remunerative basis. In other rural areas that are better populated the prospects are, however, more promising.

Broadly, the conclusion reached is that a potential demand of something like 230 million units per annum may be expected within the course of the next ten years. Needless to say, however, the estimate may be far from accurate, for there are considerable difficulties in the way of arriving at any reliable forecast. The extent to which farms will employ electric power is a question that no one can correctly answer. At the end of last year 1770 farms were connected to public supply mains; but, as a whole, they did not make any appreciable use of electrical power. In the majority of cases the current was used for lighting only, and the average consumption per farm amounted to 230 units in the year. Where current was also used to a limited extent for domestic and power purposes the average consumption ranged from 450 to 560 units; where it was used more extensively for these purposes from 2350 to 2600 units were consumed. One of the problems before those who desire to develop agricultural loads is to find ways and means of inducing farmers to employ electricity for power and domestic purposes. Propaganda and demonstrations are necessary, but no amount of persuasion will produce the desired result unless the current is cheap. Unfortunately, efficient generation does not necessarily result in a cheap supply. Transmission and distribution have the effect of increasing the price of units, and the smaller the population of a given area the more important does cheap distribution become. The British Electrical Development Association has divided rural electrification into three distinct classes: (*a*) electrification of villages which are receiving the overflow population from adjacent towns; (*b*) electrification of villages in which the bulk of the population works on the land; and (*c*) the electrification of isolated farms. In all these cases cheap distribution is essential, but more particularly is it so with isolated farms. When the Electricity Commissioners issued their new code of overhead lines regulations we expressed the opinion that they did not help engineers very much in the way of supplying sparsely populated rural areas. That, apparently, is also the opinion of the sub-committee that was appointed to investigate and report on the nature and extent of the potential demand, for it asks the Commissioners to undertake a review of their regulations within the course of the next two years with a view of effecting further reductions in the cost of rural lines by relaxations as regards ground clearance and factors of safety, and to consider the practicability of providing for different classes of construction for different conditions of supply. An appendix to the Commissioners' report shows that low-tension four-wire lines that originally cost £582 per mile can be now erected for £476 per mile, and lines that cost £697 for £614. The savings have been brought about by the Commissioners' new regulations, but they are obviously inadequate. Lines costing such sums of money may be permissible for the supply of current to villages where there is a fair population and where they are tapped at points in closer proximity. For supplying isolated farms which may be separated by considerable distances, however, much cheaper lines are needed. There is much to be said for a high-pressure distribution system as advocated by Mr. F. H. Clough, and it is to be hoped that if the Commissioners see their way clear to revise their present code of regulations—and we trust that they will do so at an earlier date than the sub-committee suggests—they will not fail to take some such system into consideration.

The findings of the sub-committee that was appointed to report on the bearing and general effect upon rural development of the price of supply and cost of electrical equipment show how futile it is to imagine that the Government's "gridiron" is going to provide cheap electricity in all parts of the country. The capital expenditure incurred by the undertakers per head of population and the probable consumption of electricity per capita are vital factors in determining the prices which can be offered consistent with remunerative working. Consideration of these matters has led to the conclusion that, in the case of the remote and sparsely populated areas, where a consumption of more than 30 units per head of population per annum can scarcely be expected, the charge for lighting with low-pressure distribution might range from 9d. to 10d. per unit, and that for other purposes from 3d. to 4d. per unit. In the case of the most remote rural areas the limits of price might extend to 1s. per unit for lighting and 4d. or more for power or other purposes. There is, of course, sometimes a possibility of tapping high-pressure lines, but unfortunately this is an expensive business, especially in the case of lines working at a pressure of 11,000 volts or more. Isolated rural consumers cannot therefore expect to obtain supplies from high-tension lines at rates comparable with those asked for from ordinary consumers who are supplied from low-tension networks in other parts of the area. No doubt, in due course, a fair number of rural parts will get current at reasonable prices, but unless there are drastic alterations in the regulations governing the erection of overhead lines the possibility of developing agricultural loads in many of the sparsely populated areas appears to be very remote.

Literature.

Modern Roadmaking, with Special Reference to Materials and Plant. By Harold Bradley, M. Soc. C.E. (France), M.I. Struct. E., and C. C. Hancock, M.I. Struct. E., M.R.S.I., A.M. Inst. T. London: The Contractors' Record, Ltd. Price 15s.

This book treats of the basic materials of road construction, their application, and the plant used. The authors explain in their preface that the design of a road is not considered, their work being intended to supplement others on "the road problem," and their purpose, expressed generally, to "co-ordinate the professional and commercial points of view." The scope of the book is, however, considerably wider than those of some recent books of a more pretentious character relating to road engineering, since most of the work involved in making cuttings and embankments and in preparing the carriageway is described in greater or less detail, according to the extent to which machinery or plant is used, and the degree of complexity of the materials. This, rightly or wrongly, is understood by many road surveyors to be the significance, in this connection, of the first word of the title.

Without questioning the honesty of purpose of the authors, of which the book furnishes internal evidence, the contention that there is something lacking in the proper relations between professional engineers and the contractors or firms with whom they deal, cannot be allowed to pass unchallenged. The book tends to enhance the importance, the responsibility and the prestige of the commercial man at the expense, it is to be feared, of the professional engineer. Few will grudge to manufacturers of highway plant and materials the praise which is due to them for the foresight and intelligence which they exercise in respect of experiments and of research work; but, since the main object is commercial in most cases, and risks are seldom incurred merely for the benefit of the public, it is difficult to accept the authors' view that the public owes them a debt of gratitude. Road surveyors, to whose efforts many improvements in plant and materials are due, do not expect to gain extraordinary prestige on that ground.

The authors' method in respect of exposition is somewhat disturbing to a professional man's sense of impartiality, for they state that "as far as practicable, we have mentioned materials and plant with which we have had personal practical experience during careers extending each over twenty years, but we have had perforce in several instances to accept the claims made by manufacturers." The result is that the book is, in effect, an advertisement for relatively few of the many firms which supply plant and materials for road work—that is, those firms the specifications of which are given in full and the materials or machines of which are described. Other firms are mentioned with, in a few cases, brief descriptions of their specialties, but many receive no notice at all. In the short chapter on surface dressing with bitumen, the materials of one firm and the spraying machine of another are found "in splendid isolation," though this would have seemed to be a case for useful comparisons and discussions of materials and plant.

It is not to be understood from these criticisms that the basis of the work is entirely on the commercial side, for considerable use has been made of typical and of authoritative specifications, and extracts from British standard specifications. The authors have, too, drawn upon their own experience to an extent sufficient to make the book, within its limits, a thoroughly practical one. It is very well printed, and there are many appropriate illustrations, including 79 plates. It is commended to the profession in a Foreword and an Introduction, written respectively by the Director-General of Roads and the President of the Institution of Municipal and County Engineers.

BOOKS RECEIVED.

City of Providence, R.I. Annual Report of the City Engineer for the Year 1927. Providence: The Oxford Press. 1928.

Collected Researches of the National Physical Laboratory. Vol. XX. 1927. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 18s. 6d. net.

Surveying: Theory and Practice. By R. E. Davis, F. S. Foote, and W. H. Rayner. London: The McGraw-Hill Publishing Company, Ltd., 6, Bouverie-street, E.C. 4. Price 25s. net.

The "Scientific American" Cyclopedia of Formulas. Edited by A. A. Hopkins. London: The American Book Supply Company, Ltd., 86, Strand, W.C. 2. Price 27s. 6d. net.

The Tod River Water Scheme, South Australia.

By the courtesy of Mr. Herbert E. Bellamy, M. Inst. C.E., M.I. Mech. E., the Hydraulic Engineer of the State of South Australia, we have received a copy of a brochure prepared for use on the occasion of the formal opening of the Tod River Water Scheme at Thevenard, in June last, at which the ceremony was performed by the Hon. M. McIntosh, the Commissioner of Public Works. We have on several occasions

FIG. 1—MAP OF TOD RIVER WATER DISTRICT

in the past referred to this somewhat remarkable undertaking during the time that it has been under construction, and, with the aid of the data contained in the brochure, we are now enabled to give our readers the following additional particulars.

The area covered by the Tod River scheme lies in the Eyre Peninsula, which is situated between Spencer's Gulf and the Great Australian Bight, and

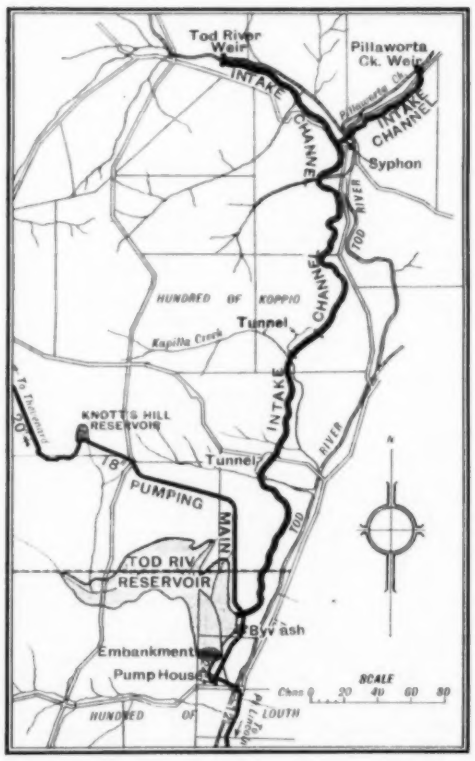


FIG. 2—INTAKE CHANNELS, RESERVOIRS AND PUMPING MAIN

which comprises, approximately, 23,000 square miles. The greater part of the district is agricultural land, the balance consisting of sand ridges and limestone flats. In the southern portion of the Peninsula, and extending along a portion of the eastern coast line, is a series of low ranges and high country, and the only well-defined watercourses exist in these low ranges, the principal of them being the river Tod. The river Tod, it may be explained, was discovered in March 1839, by an exploration party, headed by one Robert Tod.

The remainder of the Peninsula is practically barren of water, except the Polda Water Bearing Area—approximately 1500 square miles—and the Wurkagie-Witera Water Area, much smaller in extent, where potable water may be obtained from shallow wells. The rainfall, which is not heavy in any part of the area, varies from but 10in. in the north, near Cape Thevenard, to approximately 20in. in the south, at Port Lincoln—see Fig. 1.

The country is served by a main line of railway, 3ft. 6in. gauge, from Port Lincoln to Cape Thevenard—with branch lines—which runs generally parallel with the Western Coast line for a distance of some 270 miles. The extension of the railways through the Peninsula, and the consequent rapid opening up of the country to settlement, made the problem of water supply a matter of grave concern to the Government.

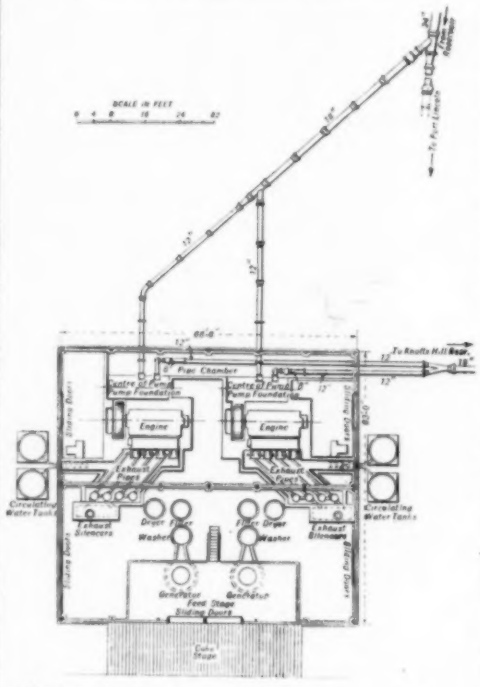


FIG. 3—ARRANGEMENT OF PUMPING PLANT

In 1916 a Royal Commission was appointed to inquire into the matter, and it, after making exhaustive investigations, recommended that the Tod River Water Scheme, which had been reported on by the late Mr. C. A. Bayer, M. Inst. C.E., then Hydraulic Engineer, should be proceeded with. The scheme had previously been described in 1914 by Mr. J. T. Turner, Engineer for Surveys. The Tod River has a catchment area of 68 square miles, which lies in the southern and more rainy portion of the Peninsula.

The Commission, in making its recommendation, reported, *inter alia*, as follows:—"No other portion of South Australia is so sorely in need of a permanent water supply as Eyre Peninsula. Unless provision is made in this direction without delay disastrous results to settlement, especially in the hundreds which have been opened up in recent years, are inevitable. Through the absence of an adequate water supply, the development of vast areas of agricultural and grazing land is being retarded." And so the carrying out of the Tod River scheme, which is designed to supply water throughout an area of no less than 10,000 square miles, was undertaken, notwithstanding that it involved the conveyance of water for a distance of nearly 250 miles from the source. The area of supply is that contained within the dotted lines seen in Fig. 1.

In brief outline, the scheme includes the construction of weirs in the river Tod and in its tributary the Pillaworta creek; the leading of the water by gravitation to a large reservoir formed by the construction of an embankment; and the pumping of the water from that reservoir to another, smaller, reservoir at a higher elevation, from which the water might gravitate through a trunk main, 240 miles long.

Constructional work on the scheme, which is being carried out by the Hydraulic Engineer's Department under Mr. Bellamy, was begun in the year 1918, the Resident Engineer being the late Mr. Edgar J. Bradley. Mr. Bradley died in 1925, and from October, 1926, to date, all the works have been carried out under the supervision of the District Engineer, Mr. John I. Miller. The head works and the pumping station were completed early in 1924, and since that time 500 miles of trunk and reticulation mains have been laid.

The weirs in the Tod and the Pillaworta are of concrete and are furnished with gates which control the flow of the streams into two intake channels, which are combined into one larger channel, as seen in Fig. 2. The main intake channel, which is concrete lined, is some 5¼ miles in length, and it has a maximum carrying capacity of 12,460,000 gallons per hour, or at the rate of practically 300,000,000 gallons per day. It is surface work for the most part, but it passes through two tunnels on the way, the longer being apparently some 22 chains in length and the shorter about 13 chains, these lengths having been obtained by scaling the drawing. Its delivery is into a reservoir, which has been formed in a valley adjoining the Tod River valley by the construction of an earthen embankment, 1153ft. long on the crest and 82ft. high above the bed of the creek on which it is built, with a central clay puddle wall. The reservoir, or lake, thus formed has a capacity of 2,400,000,000 gallons, and a water surface, when full, of 335 acres. The top water level is 491ft. above sea level, which level can be drawn down to 417ft. 6in.

This reservoir supplies, by gravitation through a 12in. pipe line, Port Lincoln—see Fig. 1—which is the chief township in the Eyre Peninsula, and has an approximate population of 2000, which is scattered along the water front. The whole area has been completely reticulated, and a circular reinforced concrete reservoir, with a capacity of 500,000 gallons, has been constructed to provide local storage in case of the temporary closing down of the supply main and also to assist in meeting the peak demand. Provision has also been made to supply small townships and country land between the high levels and the seaboard.

From this reservoir, too, water is pumped through a rising main, 18in. in diameter, and about 2½ miles long, to a further reservoir, known as Knott's Hill Reservoir, which is concrete lined and which has a capacity of 5,000,000 gallons and a top water level of 873·50ft. It is from this reservoir that water gravitates to Thevenard, 240 miles away to the northward. For raising the water into it there are two sets of Thompson 8in. four-stage turbine pumps, each designed to deal with 1000 gallons of water per minute, so that, with both working together, a volume of over 2,800,000 gallons could be pumped in twenty-four hours. The centres of the pumps come at 415·75ft., and the pumps are always submerged. The arrangement of the pumping plant is shown in Fig. 3. A portion of the supply outlet to Port Lincoln has been enlarged and an 18in. branch, which forks into two 12in. branches, taken off it to the suctions of the pumps. The discharge pipes from the pumps are 12in. in diameter, and they are joined by a breeches piece to the 18in. rising main to Knott's Hill reservoir. Each pump is driven by a 370 B.H.P. suction gas engine, and a Venturi meter records the quantity of water pumped.

The trunk main which runs from Knott's Hill Reservoir to Cape Thevenard is, as has been said, approximately 240 miles long. It varies in diameter from 20in. to 10in., for branches are taken off from it

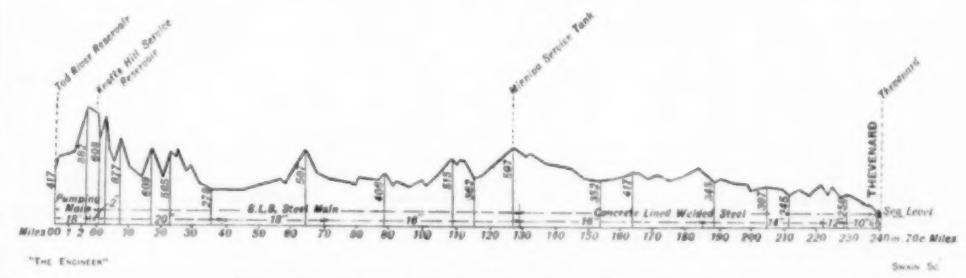

Tod River Reservoir
Knotts Hill Service Reservoir
Minnipa Service Tank
Thevenard
THEVENARD
Pumping Main
G.I.B. Steel Main
Concrete Lined Welded Steel
Sea Level
Miles 00 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 0m 70c Miles
"THE ENGINEER"
SWAIN Sc.

FIG. 4—PROFILE OF THE THEVENARD TRUNK MAIN

at various places, and others will doubtless be taken off as time goes on. In fact, it is stated that branch and reticulation mains will aggregate some 1000 miles in length. There are, first of all, lengths of 21in., 18in. and 16in. double and single lock-bar steel pipes, and then some 110 miles of "Hume" cement-lined welded steel pipes, with diameters varying from 16in. to 10in. A profile showing the route of the main, as well as that of the rising main from the pumping station, is given in Fig. 4. The main was laid along the route of the railway line, so as to facilitate the transport of pipes, materials, &c. A break pressure storage tank has been constructed at Minnipa, 128 miles from Knott's Hill reservoir. It is a concrete reservoir of the circumferentially reinforced type, and it is 238ft. in diameter. With a depth of 18ft. of water in it, it has a capacity of 5,000,000 gallons. Its top water level stands at 614·5ft., or 259ft. below the top water level of Knott's

Hill reservoir. Further break pressure tanks are proposed at Pimbaacla and Maltee.

The expenditure upon the undertaking to date has been £2,500,000, and the estimated total cost of the scheme, when completed, is given as being in excess of £3,000,000. It is calculated that the revenue resulting from its operation will not amount to more than one-half of 1 per cent. on the capital outlay. It is considered, however, that the indirect benefits which the State will experience in consequence of the enhanced productivity of the country, the closer and more profitable settlement, and increased population, will compensate, to a very great extent, for the loss involved in the undertaking.

A New High-Compression Solid Injection Oil Engine.

With many years of practical experience in the design and building of vertical steam and gas engines for stationary purposes, such as the driving of electric generators to draw upon, Browett, Lindley and Co., Ltd., Patricroft, Manchester, has entered the ranks of builders of oil engines using heavy fuels. The engines are of the cold-starting airless-injection type operating on the four-stroke cycle and are intended for direct coupling to dynamos, pumps, &c. In their design special attention has been devoted to the means of control, and whilst each atomiser can be primed separately, a single handle controls the starting and stopping of the engines through cam gearing and a master air valve.

Three of these engines—two of 200 horse-power and one of 100 horse-power—have been built for the Lurgan Urban District Council for the generation of electricity. The larger engines have each four cylinders, 16in. in stroke by 12in. in diameter, and are rated at 200 horse-power at a speed of 330 revolutions per minute. The engine illustrated on page 151 is shown coupled direct to an alternator of 130 kW capacity, generating current at 390 volts, three-phase, 50 periods. The output is 160 kVA with 0·8 power factor.

The engine is provided with forced lubrication throughout. In the design of the bed-plate cored passages are provided for the lubrication system, thereby avoiding complication of pipes and troublesome joints, while giving increased accessibility to the internal parts of the engine. The frame is designed so as to enable engines to be built with two to six cylinders; the casting being in one piece for two and three-cylinder engines, in two pieces for four-cylinder engines, and in two parts for engines with six cylinders. It is of the box type and takes compression stresses only, leaving the tension stresses to be taken by through bolts which extend from the bed-plate to the cylinder heads.

The cylinder liners are of a straightforward cylindrical shape so as to avoid objectionable casting stresses. They are bolted at their upper ends to the cylinder head, leaving their lower ends free to expand; the water joint with the jacket being maintained by means of a rubber ring as shown in the sectional views. The cylinder heads will be seen to be of clean design, giving ample water passages round the valve ports, and are free to expand vertically. The water jacket entirely surrounds the flanged connection to the liner, and there is no undue mass of metal at this point to cause unequal expansion and contraction stresses.

The pistons are made in two parts to facilitate their removal and replacement through the large inspection doors in the frame. It will be noted that in case of removal this arrangement enables the piston crown to be suspended inside the cylinder by means of a bolt from the atomiser opening. The nuts on the connecting studs are removed and the lower or crosshead portion of the piston is swung out through one of the doors in the frame while still on the connecting-rod. The crown can then be lowered and removed through the doorway on the opposite side of the frame. This arrangement is particularly useful when the engines are used for marine work and headroom is limited.

A noteworthy feature in connection with the exhaust valves is that they are made of special heat-resisting metal. Each valve with its cage can be readily withdrawn for cleaning and inspection purposes. In addition to the inlet and exhaust valves each cylinder head is fitted with a relief valve. The valve gearing is operated from the cam shaft which is operated by spiral gearing from the crank shaft.

A separate fuel pump and gearing is provided for each cylinder, but all four are controlled by the one governor and the fuel supply is common to all. The fuel flows by gravity from a tank through the supply pipe to a suction valve and to the injection pumps. As will be seen in Fig. 2, they are situated immediately above the cam shaft. The pump bodies are solid blocks of steel in which the various ports and passages are machined. The pump plunger D is operated by the lever C, which is moved rapidly at each revolution of the cam shaft by the lift of the cam B. This cam is adjustably mounted on a carrier keyed to the cam shaft. At the correct moment in the cycle of operations the fuel is forced to the atomiser and is driven through the nozzle in the form of a fine spray into the combustion chamber. The travel of the pump plunger being always the same, the commencement of the injection of the fuel takes place at a fixed point in the engine cycle no matter what the load may be. The amount of fuel injected is proportioned in accordance with the load on the engine by the opening of a spill valve—which also acts as a suction valve—before the end of the stroke of the pump, the remainder of the fuel being by-passed to the fuel tank. The position in the pump stroke at which the spill valve opens and at which fuel injection ceases is varied by means of the governor in accordance with the load on the engine. The simplicity of the pumps is pronounced—all the valves are spring loaded. The governor is of the vertical centrifugal type. As the speed increases the governor causes the control shaft K to be rotated through an angle. The roller on the fuel control lever H rests on the cam I, which is mounted on the shaft K. It will be observed that one end of the lever H is attached to a small lever which is moved up and down by the stroke of the fuel pump and that the tappet E rests on an adjustable point on the lever H and is also moved up and down at the same time as the plunger D. When the fuel pump plunger is about to commence its delivery stroke there is a clearance between the tappet E and the suction valve F. This clearance varies according to the position of the roller on the control lever H on the cam I, so that when the governor is revolving at its topmost speed, *i.e.*, under no load, the cam is at the limit of its movement in a clockwise

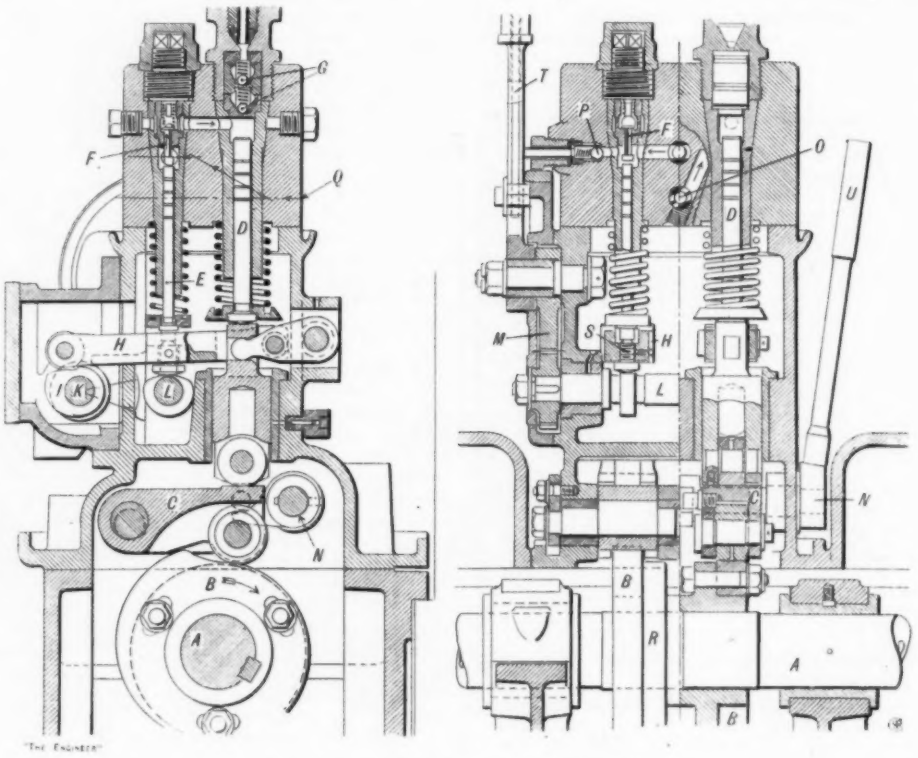


Fig. 2—Fuel Injection Arrangements

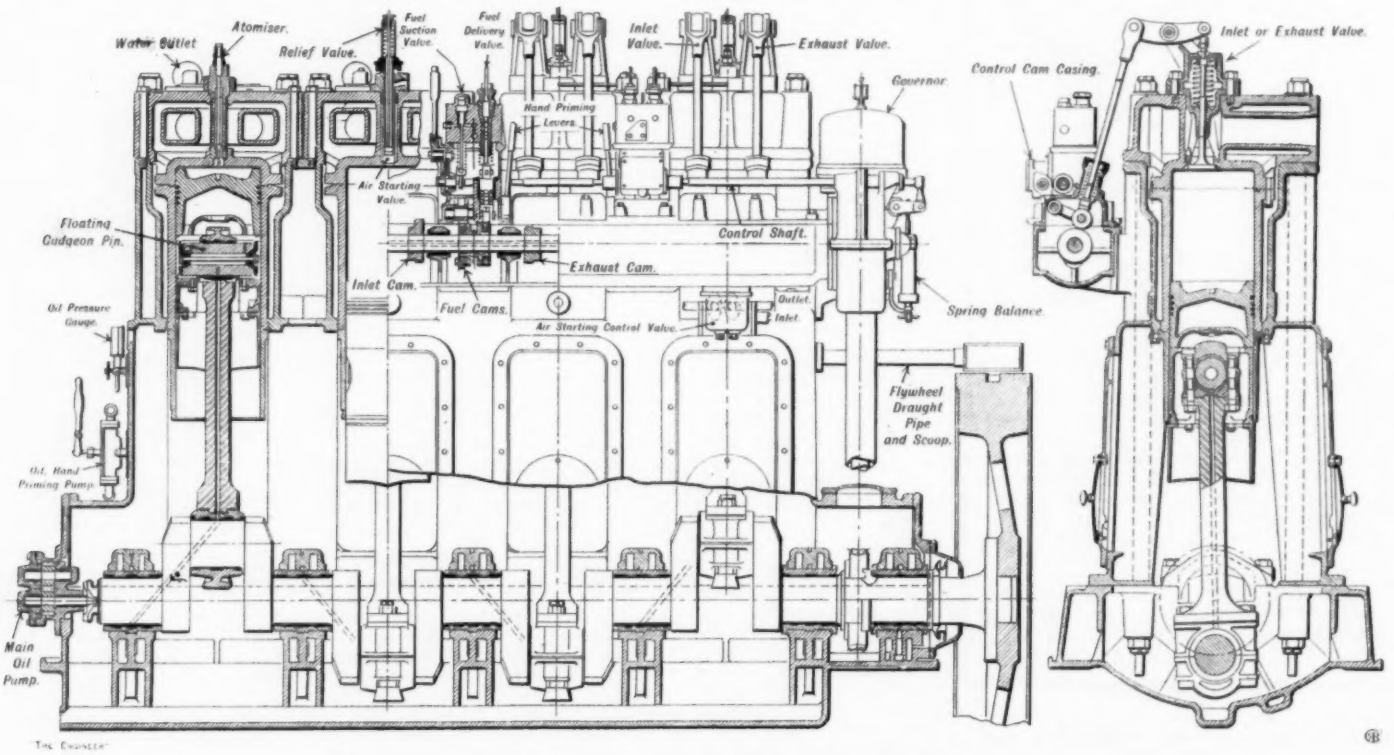
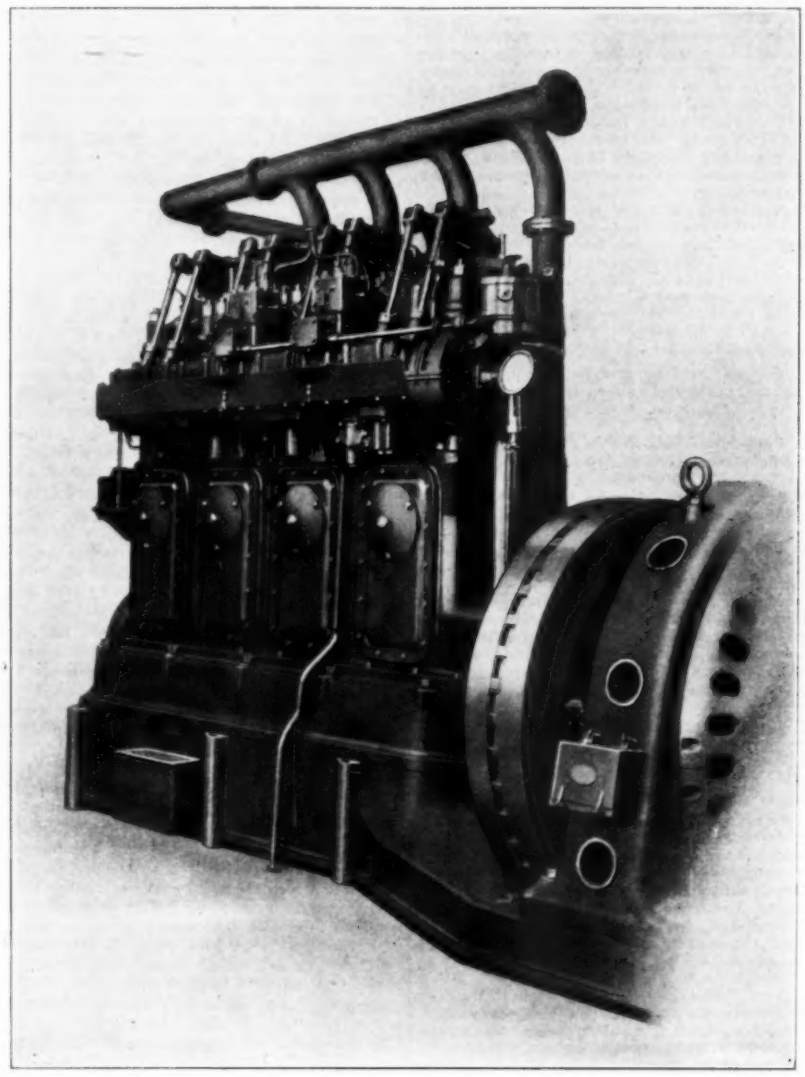


Fig. 1—Sectional Elevation and Cross Section of 200 H.P. Oil Engine

200 H.P. AIRLESS-INJECTION OIL ENGINE

BROWETT, LINDLEY AND CO., LTD., PATRICROFT, MANCHESTER, ENGINEERS



direction and the clearance is a minimum. When the governor is revolving at its slowest speed the clearance is a maximum. It will therefore be seen that while the plunger D is travelling upwards on its delivery stroke the tappet E is also moving upwards, and after it has travelled a distance equal to the clearance it lifts the suction valve S from its seat, and the fuel for the remainder of the delivery stroke, instead of being forced to the atomiser, is returned through the suction valve F and the non-return valve P to the tank. In this manner the amount of fuel delivered to the engine is regulated according to the requirements of the load.

The control lever T operates on the small cam shaft L through a quadrant and pinion. Under each spill valve tappet there is a cam mounted on the shaft L and these cams are so arranged that when the hand control lever T is in a horizontal position the suction valves of the cylinders corresponding to those to which starting air is admitted are lifted from their seats. This obviates the possibility of the fuel oil being admitted to any cylinder at the same time as the air for starting purposes. The fuel pumps of the cylinders to which starting air is not admitted operate in the normal manner. When the hand control lever T is in the vertical position the cams on the shaft L lift all the spill valve tappets and thus hold up the suction valves of all the fuel pumps and prevent fuel being pumped to any of the cylinders. This is the "stop" position. In the running position—that is, when the lever T is midway between the two positions just mentioned—the cams on the shaft L are all inoperative and each fuel pump operates normally. U is the lever for hand priming, and it, when moved to and fro, operates the short lever N which engages with the lever C and causes the fuel pump plungers D to be moved up and down independently of the driving cam. By this means the fuel system can be primed and the atomisers tested.

Forced lubrication is provided by means of a gear pump to the main bearings, cam shaft and cams. It will be observed that the pistons are long to prevent the possibility of the lubricating oil from the gudgeon pins being conveyed to the cylinder walls. The oil is taken through channels to a special chamber or underbase, leaving the crank wells practically dry. The oil system can be primed to the necessary pressure by hand before starting up. Strainers for the oil are fitted in duplicate. This system of lubrication has been found extremely economical, a consumption, we are informed, of 0·0002 gallon per brake horse-power per hour having been obtained.

The engine can be started from cold and take its full load in a very short space of time. The compression pressure is approximately 400 lb. per square inch, and that of the starting air 350–375 lb. per square inch. No compression easing gear is necessary for starting.

The fly-wheel is of the plate wheel type. It is bolted to a solid flange on the crank shaft, a form of construction adopted by the makers in their steam and gas engine practice. The fly-wheel end of the crank shaft is fitted with a sealing gland to prevent the escape of oil vapour which may find its way to the coils of electric generators. The crank shaft is vented and cooled by means of the fan action of the fly-wheel which forces pure air into the crank case and ejects the heated air to the atmosphere.

The scantlings and materials of the engine conform to standard specifications and will pass Lloyd's rules and ratings, and the performance of the engines conforms with the British Engineering Standards Association Specification No. 213 for Heavy Oil Engines of the Airless Injection Cold-starting Type for electrical purposes. The design of the fuel injection system is such as to enable the use of fuels covered by the B.E.S.A. Specification No. 209 of standard fuel oil for heavy oil engines, while the lubricant used conforms to the type of lubricating oils prescribed by the Diesel Engine Users Association.

The following details of the operation of these engines by the Lurgan Urban District Council for the quarter ending December 31st, 1927, have been supplied by the makers :—

The station contains three units as follows :—Two each of 130-kW normal capacity, one of 70-kW normal capacity. Makers guarantee fuel 0·42 on full load, 0·45 on three-quarter load, 0·50 on half load, 0·55 on quarter load. Lubricating oil 0·0003 gallon per B.H.P. hour, these figures being easily obtained without tolerance during tests.

The duties are waterworks pumping and town's electric supply as follows :—Load factor : pumping station supply, 70 per cent.; town's supply, 27 per cent. The following figures contain all the fuel oil and lubricating oil used in the station, *i.e.*, engine starting up and running governing, adjusting and light load trials by makers as well as town's supply :—Units generated in station, 100,000; units sold at 2·8d. per unit, 87,803 equals £1024 4s.; meter rents, £20 2s.; total, £1044 6s. Pumping station units 59,212, which, operating at seventeen hours per day, give an average demand equals 40 kW. The maximum demand by station equals 90 kW. The average load factor on units generated per quarter of 2190 hours equals

$$\frac{100{,}000 \times 100}{\text{kW } 90 \times 2190 \text{ hours}} = 51 \text{ per cent.}$$

The average load factor on units sold equals 45·4 per cent. Fuel oil per unit generated, 0·815 lb. at 0·67d. per pound = 0·55d.; fuel oil per unit sold, 0·93 lb. at 0·67d. per pound = 0·625d.

Costs.

	Per unit generated. d.	Per unit sold. d.
Management charges	0·35	0·40
Fuel oil charges	0·55	0·62
Lubricating oil and stores	0·03	0·04
	0·93	1·06

Seeing that the foregoing figures contained the governor tests, &c., detail figures were taken out on a run of two weeks' duration, the average figure being as follows :—Fuel oil per unit, 0·66 lb. at 51 per cent. load factor; lubricating oil, 0·0006 gallon per B.H.P. hour; corresponding to 0·0003 gallon per B.H.P. hour on normal load, the standard method of giving lubricating oil consumption. The cost per unit generated on the latter test is as follows :

	d.
Management charges	0·35
Fuel oil	0·455
Lubricating oil and stores	0·025
	0·830

The fuel oil 0·66 lb. per kW referred to B.H.P. with the test efficiency of the generator of 87 per cent. for the corresponding load was 0·427 lb. per B.H.P. hour, the makers' guarantee being 0·50 lb. per B.H.P. hour.

Electric Motors and Control Switchgear.

(*From a Correspondent.*)

In these days of high-speed production, complicated manufacturing processes and equally complex machinery, the time of the works engineer is pretty fully occupied, and he has little to spare for the study of electrical problems. Electrical drive is now employed in almost every industry, because it is so convenient and because electric motors and apparatus have been developed until, once installed, little attention is required beyond the ordinary maintenance routine.

But it is necessary, if the best results are to be obtained, that a wise choice of equipment should be made in the first instance.

As regards quality, both in motors and in control gear, the purchaser is safe if he deals with British firms of repute, since their manufactures are uniformly good. It is in the choice of the type of motor and control equipment best suited for the particular drive that care must be exercised, and it is hoped that the advice which follows will be found helpful.

System of Supply.—The alternatives are direct—or continuous—current and three-phase alternating current, but the choice of system and of voltage of supply is usually determined by the source of supply available, be it a municipal authority or a public supply company.

While direct-current machinery is usually regarded as easier to understand, it does not follow that it is easier to maintain. The latter is not by any means always true. In any case, the use of three-phase alternating current is rapidly increasing in all industries, where such a supply is available.

Type of Motor.—The type of motor best suited to any particular drive is determined chiefly by the "starting torque" required, *i.e.*, by the effort necessary to start the machinery from rest. For example, the type of motor suitable for driving a centrifugal pump, which can be started with closed delivery valve, would be quite unsuited for use on a crane. In the first case the motor starts practically unloaded, while in the second the starting torque is considerably greater than that required after the motor has attained full speed.

While it is impossible here to detail all the drives for which each type of motor is suitable, the following general statements can be made.

A shunt-wound direct-current motor or a "squirrel-cage" alternating-current motor are suitable for driving machine tools, centrifugal pumps, fans, woodworking machinery, line shafts, individual drives for textile machines and other plant requiring a starting torque somewhat less than full load torque.

A compound-wound direct-current or a "slip-ring" alternating-current motor are suitable for driving printing presses, punching and shearing machines, haulages, rolling mills, reciprocating pumps and other apparatus requiring a comparatively heavy starting torque. For cranes on a direct-current system it is usual to employ a series-wound motor.

Size of Motor.—The selection of the correct size—*i.e.*, rated B.H.P. output—of motor for a particular duty is more important than is often supposed. In the first place, the efficiency of an electric motor falls off considerably when the motor is giving less than its full output. For example, the efficiency of a 10 B.H.P. motor may be 86 per cent. at full load, 85 per cent. at three-quarter load, 83 per cent. at half-load and 75 per cent. at one-quarter load.

In the case of three-phase alternating-current motors, however, another factor, known as "power factor," comes in. This may be expressed most simply as being the proportion of the total electric current supplied to the motor which is converted into useful power at the shaft. If a motor, working at one-quarter of its rated full load, has a power factor at that load of, say, 0·6, and is taking 8 ampères, then only $0{\cdot}6 \times 8$, or $4{\cdot}8$ ampères, are being converted into useful power and employed in turning the motor shaft. Further, the amount of current which is useless, and which has, nevertheless, to be carried by the cables and the generator and transformer windings, is not $8 - 4{\cdot}8 = 3{\cdot}2$ ampères, but—

$$\sqrt{(8)^2 - (4{\cdot}8)^2} = 6{\cdot}4 \text{ ampères.}$$

The effects of low power factor are thus—

(1) Increased cost of cables, transformers, &c., to supply a given number of brake horse-power at the motor shaft.

(2) Waste of energy in the form of heat due to the additional current flowing in the cables, transformers, &c.

(3) Increased cost to the power supply authority of delivering a specified quantity of energy to the consumer. This increased cost will be recovered from the

consumer by charging him on a current basis, or by penalising him in some other way.

To avoid the losses entailed by low power factor, therefore, it is essential to install motors which are not too large for their work.

Control Switchgear.—Turning now to the apparatus for starting and stopping the motor, this consists usually of two items, the switch and fuses—or circuit breaker—for connecting the supply to the motor, and the starter, the function of which is to apply the power gradually to the motor until the latter has attained full speed.

Fuses are placed in the circuit as a "weak link" which will give way—by "blowing the fuse"—if the load upon the motor exceeds a certain safe value. Fuses, however, possess several very serious disadvantages. They are uncertain in action; time is lost in re-wiring a fuse after it has blown; unauthorised persons can insert too large a size of fuse wire in order to prevent the interruption of their work caused by the stopping of the motor; a fuse cannot distinguish between a momentary overload, which is of small consequence, and a sustained overload, the results of which may be serious; and they introduce an element of danger, owing to the possibility of the carrier bursting and scattering hot metal, if the fuse blows violently. Lastly, a fuse will only interrupt one line of supply, leaving the others alive and dangerous.

An automatic circuit breaker, which combines the functions of switch and fuses, has none of these objections. It is capable of very close setting; it can be re-closed immediately without readjustment; its setting can be locked so that it cannot be tampered with; it introduces no danger; it can be made to open immediately or after a definite interval depending upon the severity of the overload; and it completely disconnects the circuit when open.

An automatic circuit breaker, fitted with "no-volt" and time-limit overload devices, will completely protect a motor from all contingencies while running.

If a stationary, direct-current motor were switched direct on to the supply, without the use of a starter, the rush of current into the motor at the instant of switching on would seriously damage the motor, and a starter is therefore an absolute necessity.

In the case of an alternating-current "squirrel-cage" motor, however, this rush of current is limited automatically to 3½ to 5 times the normal full-load current of the motor. This rush is only momentary, and the current falls as soon as the motor gathers speed, but supply authorities sometimes object to motors over 10 B.H.P. being switched direct on to the line in this way. In most cases, however, there will be no objection to switching on motors up to 15 or 20 horse-power without the use of a starter.

The difficulty then arises that the overload device which is to protect the motor while running, and is set to operate at, say, 1½ times full-load current, will open the circuit as soon as the motor is switched on, unless it is set at too high a value for safe running conditions. To obviate this, a device, known as a "double time lag," has been introduced which, while fully protecting a running motor against overloads of 25 per cent. or upwards will not operate under starting conditions.

While "direct-on" starting, as described above, is simple and effective, there are many drives in which the conditions are too severe, and in which other methods must be employed. For squirrel-cage motors there are two alternatives, "star-delta" and "auto-transformer" starting. Without going into technical detail, it may be said that the effect in each case is to reduce the voltage—or pressure—applied to the motor, and so the current taken by it, at the moment of starting.

It follows that the torque or effort against which the motor will start is also reduced. Star-delta starting is only applicable to cases in which the starting torque does not exceed one-third to one-half of full-load torque. Auto-transformer starting can provide a starting torque equal to 60 per cent. of full-load torque, the starting current being then about 2½ times the full-load current.

Where the torque at starting exceeds 60 per cent. of full-load torque, a slip-ring—or wound rotor—motor must be employed, which allows resistances being inserted in the rotor circuit for starting purposes. With this arrangement and using a resistance "rotor starter," over twice full-load torque can be obtained at starting, with almost proportional starting current.

Star-delta starting is thus suitable for wood-working machinery, centrifugal pumps, machine tools with fast and loose pulleys, fans, textile machinery, refrigerating plant, &c.; auto-transformer starting for bread-making, confectionery, laundry (except hydro-extractors) and other machinery in which the starting torque is slightly greater; and slip-ring motors with rotor starters for heavy machine tools, hydro-extractors, elevators and conveyors, flour mills, paper mills, cement works and steel works.

In starting gear of all types some protection is necessary against an interruption of the supply; otherwise, when the supply is switched on again, the motor will be damaged through the starter being left in the "running" position, in which the mains are directly connected to the motor terminals. This simple device is known as a "no-volt" trip, and immediately returns the starter to the "off" position, should the supply be cut off.

An emergency push, connected in the circuit of the no-volt trip and arranged to be worked by the operator's hand or foot, enables the motor to be stopped quickly, and is a most valuable safety device. By its means more than one serious accident has been averted, when the operator's hand or clothing had been trapped in the machine.

Where it is essential that the motors driving successive machines in a process, as in flour milling, should be started in the correct order, to prevent choking, this can quite easily be arranged by means of the no-volt trips and auxiliary contacts in the control gear, while the stoppage of one motor will, in such cases, automatically cause the stoppage of the others in the series of machines.

It must be clear from the above that the control switchgear, which comprises the circuit breaker with its automatic features, and the starter, form, in effect, the brain of the motor, ordering the starting and stopping and preventing it from damaging itself or being damaged by overload or other cause. It is not surprising, therefore, that the cost of the control gear sometimes exceeds that of the motor. In fact, it is usually possible to save a considerable sum on the motor by spending a little more in buying thoroughly efficient control gear. Accurate gear, which will permit the motor to exert its maximum safe effort, yet will disconnect it before damage has been done if that safe effort is exceeded, is very much cheaper in the long run than gear which may switch the motor off before its maximum load is reached or may allow it to overheat through excessive overload.

You can have a motor large enough to carry all accidental overloads which may be thrown upon it, together with cheap control gear, or you may have a smaller motor which will do the full normal duty and control gear to protect it from abnormal conditions.

The second alternative may mean a higher total first cost, but the extra outlay will be amply repaid in reliability of the plant and immunity from breakdowns, and can be regarded as an insurance against stoppages, which are costly and irritating.

Issuing Inquiries.—A great deal of time is lost, both in the purchaser's office and in that of the manufacturer, through insufficient information being included in an inquiry for control gear, resulting in correspondence asking for additional details. Below are given schedules of the information necessary to enable the manufacturer to give a firm quotation for various types of control apparatus.

All inquiries should state:—

System of supply, voltage and frequency. Whether the neutral point of the system is earthed or insulated.

B.H.P., type—squirrel-cage or slip-ring—and speed of motor.

Details of apparatus to be driven by motor, including weight, diameter and speed of any fly-wheels or heavy rotating parts.

Type of starter required—star-delta, auto-transformer or rotor resistance—or switch for "direct-on" starting.

Approximate percentage of full-load torque against which the motor is required to start, number of times the motor will be started per hour, and time to be taken in starting.

If the motor is of the slip-ring type, state the open-circuit rotor volts and maximum rotor current. These particulars are sometimes given on the motor name-plate, otherwise they can be obtained from the makers.

Particulars of any additional contacts for interlocking or remote control or special protective devices required.

Details of the method of wiring to the apparatus and size of conductors.

Examples of Typical Inquiries.

(*a*) "*Straight-on*" *Starter.*—Oil switch to control a 10 B.H.P., 960 r.p.m., squirrel-cage motor on a 440-volt, three-phase, 50-cycle supply. The switch is to be provided with double time lags to enable the motor, which drives a line shaft with fast and loose pulleys, to be switched directly on to the supply, and is to be mounted on floor stands. The incoming cable is 7/·036in., three-core, paper-insulated, lead-sheathed, and single wire armoured, and the connection to the motor is by VIR wiring in 1in. screwed tubing. The incoming cable will be brought up through the floor to the switch.

(*b*) "*Star-delta*" *Starter.*—Combined main oil switch and star-delta starter for a 25 B.H.P. squirrel-cage motor on a 440-volt, three-phase supply at 50 cycles. The switch is to be fitted with two overload and one no-volt trip coils, and contacts are to be provided to prevent the motor from being started until another motor is running, and to stop the two motors simultaneously. A remote control, hand-operated push switch is also to be supplied. All wiring will be in screwed tubing. An ammeter is to be mounted above the switch.

(*c*) *Auto-transformer Starter.*—Combined oil switch and auto-transformer starter for use in conjunction with a 25 B.H.P. squirrel-cage motor on a 550-volt, three-phase 50-period supply. Three overload and no-volt trip coils are to be fitted, and the auto-transformer, which must be oil-immersed, is to be provided with three alternative tappings, giving 50, 60 or 75 per cent. of full-line voltage in the starting position. Armour glands suitable for ·03 square inch, three-core V.B. insulated, S.W.A. cable are to be fitted on the incoming and outgoing sides.

(*d*) *Rotor Starter.*—Control unit for a three-phase, 20 B.H.P. slip-ring motor, 440 volts, 50 cycles and comprising a three-pole oil break circuit breaker, with three overload and one no-volt trips, electrically interlocked with an oil-immersed rotor starter, designed to start the motor against not more than 160 per cent. of full load torque, not more than five times per hour. The open circuit rotor voltage is 180 volts and the full load rotor current is 52 amperes. The incoming cable will be three-core paper lead S.W.A., and the connections between the control gear and the motor will be in 1½in. flexible metallic tubing.

In the above cases the prospective purchaser has definitely stated his requirements to the manufacturer, who will give his quotation accordingly. There are many cases, however, in which it is exceedingly difficult for the purchaser to estimate, even approximately, the starting torque required.

For example, the effort required to start up heavy rotating machinery, such as a hydro-extractor, depends upon a number of factors, such as the weight of the basket, weight of wet material, diameter of the rotating parts, &c., and a knowledge of the time in which the machine is required to be run up to full speed, *i.e.*, the rate of acceleration required. Given these data, the starting torque can be calculated fairly closely.

It is far better in such circumstances for the prospective purchaser to submit full details of the plant to be started, including details of both the motor and the driven machine, and to leave it to the manufacturer to put forward the type and size of starter best suited to the job. In this way the purchaser will benefit by the wider experience of the manufacturer, who is a specialist in starting problems, and will frequently find that a smaller starter, if specially designed to suit his conditions, will be more satisfactory than the standard article which would have been offered if essential details had not been submitted with the inquiry.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

FIFTY-PERIOD SINGLE-PHASE ALTERNATING CURRENT FOR RAILWAY TRACTION.

Sir,—The kind remarks of Mr. Geo. T. Pardoe bristle with points of the utmost significance, and are of particular interest owing to being unbiassed. As he very rightly states, the single-phase alternating-current system of electrical energy generation and distribution is the simplest and the cheapest, and he raises a few important points which bear on the subject in relation to general power supply. Whilst appreciating many of his remarks, I am not in agreement with most of them, bearing in mind the present-day conditions and improvements which have been developed since the early days of central power station supply.

His remarks that there is a saving in 25 per cent. of copper by the utilisation of three-phase current depends under what condition and power factor are taken into account, and probably in the old days this statement may have been true in many aspects, as the power factor of the old type of induction motor, using single-phase current, was not what to-day we would call good. Quite a different story can be put forward in 1928, and in accordance with many schemes for single-phase alternating-current railway operation, which I have had to deal with during the last five years, the saving in copper in many cases has been in favour of the single conductor earthed rail return single-phase scheme. His remarks concerning the old type of single-phase alternating-current rotary converter are also correct. There is no doubt that a better character can be given to the resulting direct current when three or six-phase currents are used for this now out-of-date purpose, as I see no real reason for the conversion of the alternating current for general purposes; so why have rotary converters at all? In the event of a certain amount of direct current being required for certain purposes, it can be very much more simply obtained, and much more reliably obtained, by the use of modern motor generators, which are better understood by the using public, and require practically no attention of a skilled nature.

Take the case of the latest type of electric road vehicle. This can now be obtained in such construction that the vehicle can receive the alternating current at the vehicle plug, and by means of a novel electro-kinetic converter carried on the vehicle, and forming an important part of the traction equipment, the alternating current is transformed into the proper current and voltage for the actual battery charging, with no loss in external resistances, as would be the case if a rotary converter were used—see The Engineer, June 13th, 1924. In this case the description is given as relating to the charging of a 100 horse-power "Paragon" battery locomotive, but the same system is used in connection with the road vehicles, and will become very valuable when the Government standardised 50-period alternating-current supply becomes in general use; but, what I do not appreciate is that unless the alternating-current section of the transformer is wound for the high and dangerous voltage of 400, it becomes necessary to tap the neutral point of the power supply, and this is not a good feature, as although the current required is very small, owing to the watts being transformed for a lower voltage, unless the three legs of the three-phase supply are loaded equally, it puts the supply system out of balance, whereas if the supply were of the simple single-phase current, the loading of the mains becomes automatically an equalised job throughout.

Another feature in connection with this matter is the fact that the transformer is started from the direct-current side, and all that is necessary for the attendant to do is to close the alternating-current line switch, and even this operation can be made as part of the starting switch on the direct-current side of the system. The fact that the rotor of the alternating-current section of the transformer does not have to produce even sufficient starting torque to start itself, this rotor can be made of very much lower resistance than if it had to start itself and its load. This feature brings in another very good thing, and that is that the efficiency is very much higher, and the power factor almost unity, which, as Mr. Pardoe will, I am sure, agree, will reduce the copper on the supply side of the question. I find that if the rotor has to start itself, and possibly its load, that it is essential to make the resistance of the rotor, relatively speaking, much higher. This, in turn, lowers the running load speed, increases the slip, decreases the efficiency, raises the temperature—for a given power on also given rating—makes the machine heavier and more costly, and the power factor is lowered, and these features are particularly serious when I have used slip-ring induction motors, although very handy, but more costly in getting even a three-phase powerful motor away.

Mr. Pardoe's reference to the use of the slip-ring rotor induction motor for speed regulation, or what may be the same thing, starting against a very heavy torque, I find that this means a high consumption in energy supply per pound-foot of torque produced, and, at least for railway traction work, is uneconomical. During the experiments on my petrol-electric omnibuses about twenty-three years ago, I tried this method, and found it unsatisfactory!—not nearly so good as the squirrel-cage rotor which I ultimately used in connection with these highly successful three-phase transmission road vehicles.

Mr. Pardoe refers to the great untouched agricultural field when he refers to the question of small motors, and this is where, I may say, my points are of the most important significance. The idea that the farmer is going

to put down three-phase alternating-current plant for his general use, at the dangerous voltages of 230 and 400 respectively, I feel certain will be most disappointing to those who are desirous of seeing this great field of power use developed as it should be. I have recently been asked to prepare a scheme on the "Paragon" system of ploughing and other general work on a large farm, and I can assure Mr. Pardoe that even with the slip-ring type of induction motor the rough and uncertain speed-torque conditions put up under this scheme made the three-phase alternating-current scheme not only uneconomical, but also quite unpractical, compared with the present operation by means of steam.

In this case the transmission lines have to have three conductors, and the cost of same compared with the cost of the simple two conductors, as is used in the "Paragon" single-phase alternating-current system were outrageously high. The load factor and the power factor were unsatisfactory, and the type of supply which I do not believe that the supply people will be glad of.

Then there is the uncertainty of the supply to be taken into the account. I am sure that Mr. Pardoe will agree with me that the public have in the past been well served, and the supply given most constant and the consequent confidence obtained, of all electric supply systems, has been built up on the reliability secured by the electric storage accumulator. In all cases which I have come across where the supply has been by means of alternating current, without the assistance of storage of energy, the unreliability factor is making great headway. I know this is particularly a fact in certain West-end general stores. Recently the light failed, and no less than £500 of stock was simply stolen by members of the public, and it is that style of thing that is making itself felt in certain directions. In my opinion, all public supply should be treated simply as a means of supplying energy, and the use of that energy should be the business of the consumer. He can then please himself if he puts in a storage system or not. He takes the risk possibly, but then that is his business and not the supply people's. Further, the metering of electrical energy is somewhat amusing in many instances. There are various types of meters which have to be hired, and in many cases the hire of meters comes to as much as the supply of energy. All this would be stopped by a modern system of single-phase alternating-current supply, with its simple distribution methods, and the high and dangerous voltage would end up in properly sealed stator windings, which would produce mechanical energy only, and not attempt the dangerous work of general domestic distribution. The gas companies and the coal companies are very much wiser, in my opinion. They deliver their goods and leave the consumer to use them as he pleases, and it must be admitted that they do good business with their wares.

In reference to railway traction by means of single-phase alternating 50-period current supply, I can assure Mr. Pardoe that costly research work in recent times has now made this possible, and, as a locomotive man, I will state that a locomotive of high power having all the characteristics of powerful express or goods type steam locomotives is now evolved, and can be placed on the market, operating silently, even with greater economy than with direct-current supply locomotives of the normal type, and what is also of interest, for given draw-bar pull capacity at given rating and train speed, they are cheaper.

I have no hesitation in stating that if the railways are really wanting to save themselves, financially speaking, by means of electrification, even of the main lines, that to-day we have the means of doing it, and with a tremendous reduction in comparative costs of installation and operation under given schedule.

Too much has been made of the low-frequency supply for railway traction. In America they have tried it, and it is found wanting. Switzerland had to go to the tremendous expense of putting down separate power stations to supply the railways only, and there are many technical people who thoroughly agree with me that the most economical proposition would have been for a general 50-period supply for both railways and industries alike, with its great commercial effect on the station and capital load factor.

The bad effects of high induction losses in the return rails and other features are conspicuous by nearly absence where carried out under the more modern operating conditions embodied in the "Paragon" single-phase alternating-current railway traction system.

I am sure that, if the Government were to have the matter thoroughly sifted in the light of modern improvements, the release of the railways from the grid would be found a very great mistake, and, further, the railways themselves would be enlightened on the subject of real electrification in a manner which they have hitherto not had the opportunity of doing.

WILLIAM P. DURTNALL.
Captain, M.I. Loco. E.

Westminster, S.W. 1, August 8th.

POSITION OF COLLIERY MECHANICAL ENGINEER.

SIR,—Kindly allow me through your journal, as a regular reader, to call the attention of interested parties to the fact that "the Departmental Committee for Mines, appointed by the Secretary for Mines to consider the qualifications of colliery officials, is now ready to receive and consider memoranda . . ."

The rapid mechanisation of collieries demands the services of highly skilled mechanical engineers, and although many groups of collieries employ such class of men, there are still many without, owing to the fact that such an official is not now recognised by the Coal Mines Act. Thirty years ago such men were considered absolutely necessary, but owing principally to lack of status—although, as is well known, colliery engineering has made such rapid strides that many mining engineers consider the time has long since arrived when part of their responsibilities should be shared by a mechanical engineer—mechanically trained engineers are turning their backs on colliery work. This subject is surely one of national importance, and conditions surely to-day, more than at any time in the history of our mines, call for highly skilled colliery mechanical engineers.

Several existing colliery engineers are members of the Institution of Mechanical Engineers, and here is an opportunity for this body to support and give evidence before the Committee now dealing with the subject, and by so doing raise the status of their members and others interested in this important branch of the engineering profession.

August 7th. OLD ENGINEER.

RAILWAY BREAKDOWN EQUIPMENT AND WORK.

SIR,—To those of us who have been connected with breakdown work, the article on this subject was very interesting and in many ways very instructive. A few comments on same may not be out of place.

The writer of the article informs us that most of the re-railments were done with the use of ramps or jacks, and only sent the crane on special information, while my experience and advice is: "Away with the crane at once to any derailment within, say, 20 miles; over that distance, certainly, try and obtain reliable information."

I believe that nine out of ten derailments can be made good with the use of the crane, thus saving time, especially when the main line is blocked. The writer of the article seems to have been more fortunate in re-railing all kinds of engines and vehicles of six wheels or more with ramps than anyone I have ever seen or heard tell of. My experience has been that it is very difficult to re-rail a six-wheeled vehicle with ramps, and hardly ever possible to do so with an engine.

The writer of the article speaks of using the torch to cut the draw-bar in some cases, which is a very good idea.

As in a very large proportion of engine derailments in my experience the engine was off the rails and the tender on, or *vice versâ*, to save the time of uncoupling, shunting and blocking the road for a considerable time, I tried a new plan. I first scotch the tender wheels well up, if the engine is off, using a pair of 24-ton hydraulic jacks at the back beam of the engine, the crane lifting the fore end. The engine is then swung well over the rails at the front till the flange comes over the rail at the back end. The jacks are then lowered till the flanges are well placed, and the front swung to suit the rails, and the job is done. For many years I have done the work in this way, and time taken is generally fifteen or twenty minutes. The other or older method takes two hours, more or less. Our intermediate draw-bar was screw and nut. For many years open keys were used for this purpose, which were heavy and difficult to handle, necessitating crawling on the ground and dealing with one pin at a time. I got a ratchet key made to simplify this work, either to slacken or to tighten up.

August 7th. A. MORRISON.

Report on the Manchester Gasworks Accident.

THE Home Secretary has received the report of Mr. F. O. Stanford, M. Inst. C.E., one of the Engineering Inspectors of the Ministry of Health, whom he appointed under Section 22 of the Factory and Workshop Act, 1901, to hold a formal investigation with regard to the accident which occurred at the Bradford-road Gasworks, Manchester, on August 23rd, 1927, when two of the gasholders were wrecked. The inquiry was held in public at the Town Hall, Manchester, on February 2nd and 23rd, 1928. Evidence was given by representatives of the Manchester Corporation, by members of the staff of the gasworks, and by various experts and eye-witnesses of the accident.

Mr. Stanford found that the evidence pointed to the general conclusion that the crown plating of one of the holders failed. This occurrence allowed the gas to escape rapidly, the holder crashed down into its tank, and the escaping gas caught fire—probably through sparking from the tearing or falling ironwork. The failure of the adjacent holder is attributed to the resulting concussion and disturbance in the atmosphere. Fortunately, no fatal consequences or serious injury resulted.

In considering the causes of the failure, Mr. Stanford points out that, so far as is known, there was no explosive gas or mixture of gas and air in the holders prior to the accident, and no explosion inside either holder took place beyond, possibly, an explosion of a limited amount of gas remaining in the holder after the bulk had escaped and been fired in the open air. Had such an explosive mixture, in fact, been present, and an internal explosion taken place, much more devastating effects would undoubtedly have resulted. The accident cannot, therefore, be attributed to an explosion. Mr. Stanford also states that there was no evidence of any wilful malpractice or foul play; nor of any misconduct, such as smoking on the works or the use of any unauthorised naked light. Nor does he attribute the accident to any fault of design or construction, although he points out that modern holders are somewhat differently designed.

The report states that the gasworks are under the control of the Gas Committee of the Manchester Corporation; they were commenced in 1878, and the holders have been in continuous use since 1881. They had been examined externally twice a year and any leaks found were stopped by means of external patches, but there had been no re-plating of either holder. Examination of samples from the material of the wrecked holders led to the conclusion that marked local corrosion, especially near the joints of the plating, had reduced the strength of the iron plates to a serious extent.

After considering whether any exceptional circumstances might have brought an abnormal stress on the structure, Mr. Stanford found no evidence of this character, and concluded that the cause of the accident was the weakened condition of the plating through corrosion and the continued use of the holders under normal working conditions when their safe working life had been passed. He recommends that the Corporation should appoint a chief engineer to take responsibility for the working and maintenance of its gas undertaking.

SPANISH TRADE ARRANGEMENTS.

LIKE France and some other countries Spain has refrained from entering into commercial treaties of a binding character for long periods and has substituted for them short term commercial arrangements which can be revoked in the event of their operation proving detrimental to the interests of the new Spanish industries. The system is not always satisfactory to the other countries concerned. One evidence of this is the refusal of Spain to renew the commercial arrangement with Sweden whereby that country was able to import iron and steel products and machinery into the Peninsula at a reduced tariff. The same advantages were naturally accorded to other countries enjoying the most favoured nation treatment. Since the convention with Sweden was signed there have been great changes in Spain in the direction of carrying out a vast scheme of national economic development, involving the creation of new industries with the aid chiefly of Spanish capital and the placing of all undertakings under Spanish control. Foreign technical aid is, of course necessary for starting industries, but, in a general way, foreign influences are eliminated as far as possible. Foreign engineers will not henceforth be employed in any of the Spanish administrations. In order to carry out this work the country is being hedged round with a fiscal barrier and with a system of prohibitions which are making it extremely difficult to do business at all. As Spain refuses to renew the commercial arrangement with Sweden so long as the latter country insists upon the maintenance of its privileges for the importation of metallurgical products and machinery into the Peninsula, it is obvious that other countries, which have similar arrangements, do not consider that the future is safe, and the only hope lies in the probability that the Spanish Government will find that it is by no means easy to carry out the programme of national development solely with the aid of national resources.

B.E.S.A. SPECIFICATIONS.

SPARKING PLUGS.

A REVISED copy of the specification for Sparking Plugs and their Accessories has just been issued by the British Engineering Standards Association. The standard tolerances for screw threads laid down in the 1917 edition of this specification having proved too fine for commercial production, the dimensions and tolerances were reviewed to see if a slight widening of the tolerances was practicable. Investigation showed that there appeared to be no reason why a small increase in the tolerances should not be allowed without impairing the efficiency of the fit, and it has been provided for in the revised specification.

The principal alterations made to the other dimensions of the sparking plug are as follows:—The No. 3 B.A. terminal thread having been found insufficiently strong for certain types of sparking plugs, No. 2 B.A. has been made the standard, with a recommendation that where a larger terminal thread is required No. 0 B.A. should be used. The standard reach has been fixed at $\frac{7}{16}$in. and where a longer reach is required for special purposes two alternative lengths are recommended. The maximum projection of the sparking plug has been increased from $2\frac{1}{2}$in. to 3in. The depth of the hexagon portion of the body has been made $\frac{1}{4}$in. (minimum).

The revised specification includes the standard dimensions for the depth and countersinking of the sparking plug holes in engine cylinders, dimensions and tolerances for the threads of taps for tapping sparking plug holes, plug and ring gauges for checking the threads on the body of the plug and in the tapped hole, and particulars of the standard copper-asbestos washer for making the joints.

Special attention is called to the desirability of using sparking plug taps having threads conforming to the standard dimensions and limits laid down in this specification when tapping holes in engine cylinders. Much trouble has been created in the past through engine cylinders being tapped out 18 mm. diameter or smaller, with the result that the makers of sparking plugs have had to supply plugs that are below standard dimensions, thus causing non-interchangeability of the standard sparking plug in the motor trade. The standard size of the tapped holes is considerably above 18 mm. and the correct dimensions for the taps are set out in Clause 8 of the specification. It is important that engine builders and dealers in taps should see that the taps are in accordance with this clause and thus eliminate the non-interchangeability of sparking plugs in the future.

Copies of this specification (No. 45–1928) may be obtained from the Publications Department, British Engineering Standards Association, 28, Victoria-street, London, S.W. 1, price 2s. 2d. post free.

THE railway companies' Bills for road transport powers passed the House of Lords on July 26th, and have now received the Royal Assent. The Scottish proposals were the subject of separate Bills, but at the last moment were combined in the main Bills of the London, Midland and Scottish and London and North-Eastern respectively.

Re-turning Lathe for Axle Journals.

A LATHE for re-turning simultaneously both journals of railway axles with the wheels in position, which has recently been built by John Hetherington and Sons, Ltd., Manchester, is illustrated in Figs. 1, 2 and 3 herewith. Fig. 1 shows a front view of the lathe, Fig. 2 a back view, and Fig. 3 is a view of the friction roller mechanism with a guard removed to show the gears and with the rollers lifted above the normal position for the purpose of illustration. It will be observed that the axle which is being re-turned is carried between dead centres in loose headstocks, the latter being adjustable along the bed to take different lengths of axles. The headstocks are fitted with the usual hand-operated barrels. The axles are driven by two friction rollers, one in contact with each tire. The rollers are built up of laminations of friction material and each is driven independently from the main driving shaft at the back of the lathe, being carried in a separate swing frame with its own independent weighting arrangement to maintain frictional contact with the tires. The rollers are mounted on ball and roller journal bearings with special ball bearings to take end thrust. The large hand wheel at the front of the lathe regulates the pressure of the rollers on the tires and is also used to disengage the rollers entirely when axles are being put in and taken out of the lathe.

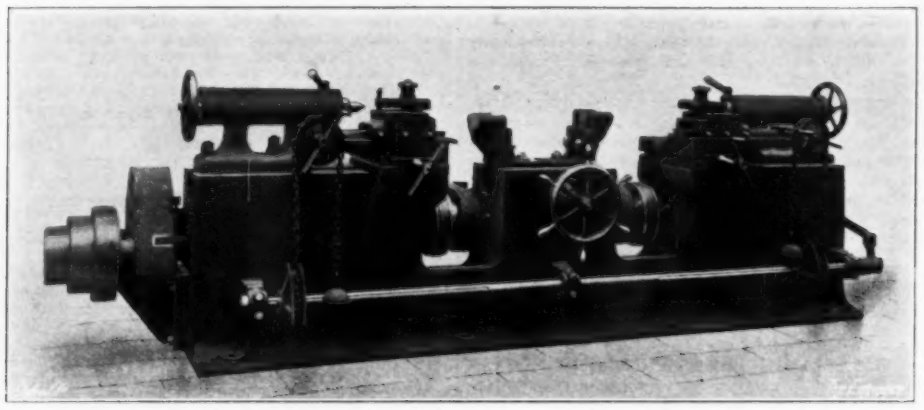


FIG. 1—AXLE JOURNAL RE-TURNING LATHE—FRONT VIEW

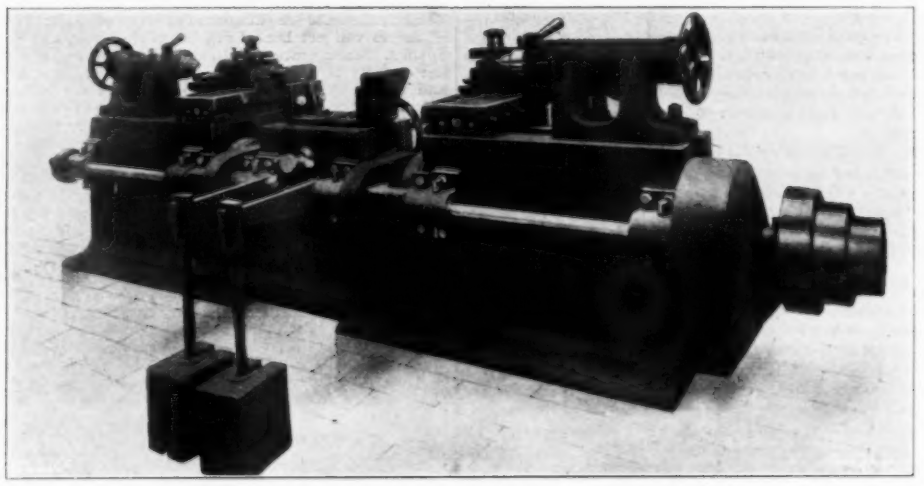


FIG. 2—AXLE JOURNAL RE-TURNING LATHE—BACK VIEW

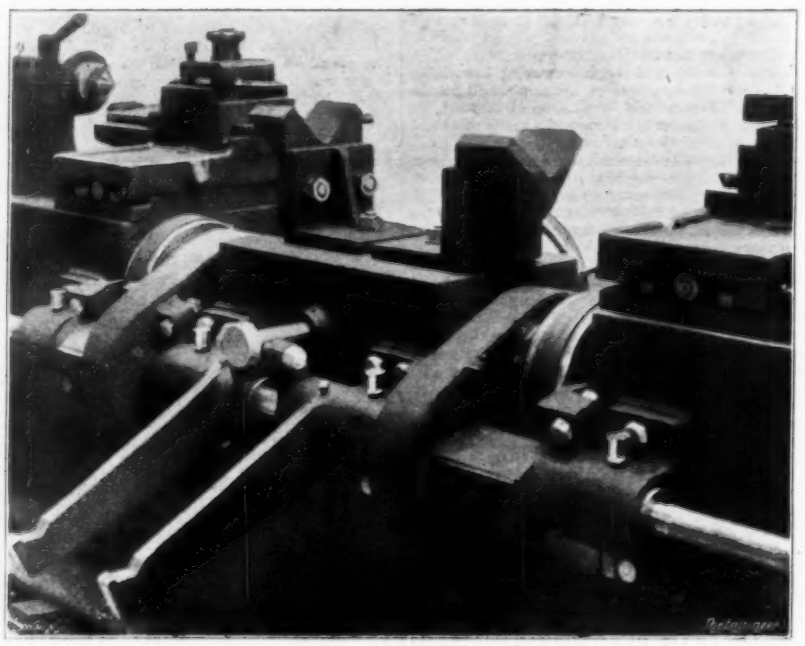


FIG. 3—ENLARGED VIEW OF FRICTION ROLLER MECHANISM

The compound slide rests are adjustable to the most suitable position for the different axles to be dealt with and the tool slides have power traverse motion. They are fitted with quick-acting tool clamps. The vee rests on the centre portion of the bed are adjustable to a suitable height to support the axles just below the centres when putting in and removing work. When the lathe is in operation the centres raise the axle just clear of the rest. To protect the bottom slide and keep it free from cuttings, lubricant, dirt, &c., the middle slides are extended to form trays. The swing frames which apply pressure to the friction rollers are each carried independently in two large bosses and do not swing about the driving shaft.

The following features can be altered to suit conditions and requirements. The main drive, which in the lathe illustrated is by cone pulley and wall mounting countershaft, may be either by constant-speed belt and change-speed gear-box; by constant-speed motor and change-speed gear-box; or by variable-speed motor. The gaps can be made to suit any gauge of wheels and the length between the centres to suit any length of axles. The saddles can be made with sliding motion on the bed having self-acting feeds instead of, as shown, and the feeds can be arranged with gear-box changes to give continuous and positive motion instead of the ratchet motion shown. If desired, the ends of the bed can be separate and adjustable to suit different gauges. The following are the leading dimensions of the lathe:—

Height of centres	10¼in.
Depth of gaps	2ft.
Diameter of wheels over flanges	2ft. 6½in.
Diameter of wheels on treads	2ft. 4½in.
Gauge of wheels	1 m.
Journals, diameter and length	4in. and 9in.
Centres of journals	4ft. 8in. to 4ft. 11in.
Length overall, axles	5ft. 9½in.
Approximate net weight	4½ tons

South African Engineering Notes.

The New Wankie Colliery.

THE Wankie Colliery is a critical factor in the industrial and financial situation of Rhodesia, and at the present time a policy of expansion is in hand, which, when consummated, will make of Wankie an even more important point in industrial South Central Africa than it is now. The constructional work is well in hand at the new colliery, and the huge Simon Carves screening and washing plant will be completed by January next. The new colliery is now delivering an output of 200 tons per day, and when, in the near future, the screening plant is completed, that quantity will be increased to 500 tons per day. Thereafter there will be a steady increase until an output of 1000 tons per day is reached. The eventual productive capacity of the new pits will, however, be 5000 tons per day, and it can safely be said that few, if any, collieries in the world have been laid out and equipped on such modern and ambitious lines as the new Wankie. The old Wankie Colliery had an output for 1927 of rather over 1,000,000 tons. The power plant at the old colliery, which transmits electricity to the new pits, is being enlarged by two 3000-kW units, comprising Belliss and Morcom turbines and British General Electric Company's generators. When this plant is completed, it will be the largest power station in Southern Rhodesia.

Record Gold Output.

As was generally anticipated, the Transvaal gold output for May established another new record for the industry. The mines in May produced 886,186 oz. of gold, exceeding the previous best monthly total—that of March last—by 8806 oz. in weight and £37,406 in value.

Latest Rand Mining Practice.

When the new vertical shaft at the City Deep Mine on the Rand comes into commission, it will mark an epoch in the history of this Central Rand mine. By means of two vertical shafts, the lower of which is sunk some 60ft. east of the upper section, it will be possible to haul 250 tons per hour from a vertical depth of 7000ft., besides lowering and raising white miners, natives, and the material necessary to mining operations underground. The scheme of haulage adopted at the City Deep consists in sinking a vertical shaft, 7000ft. deep, in two stages of 4500ft. and 2500ft. The upper section will stop at the seventeenth level, where it will make connection with the two—old—incline shafts, and the reef will be attacked from the lower section by cross-cuts at each level. As all ore and development rock will gravitate through ore passes cut between the twenty-sixth and thirty-third levels, it follows that every ton of rock hauled out of the mine through this shaft will have to be lifted 7000ft. before it reaches the collar of the shaft, or from a depth 1442ft. below the sea level at Table Bay.

Most of the ore hauled from mines of the Witwatersrand is raised by means of skips that tip the rock on reaching the surface. But when the new shaft is put into service skip haulage will be replaced by a system of hauling loaded trucks from the bottom of the mine, a method adopted on the coal mines to prevent the powdering of the coal. 8-ton trucks, 13ft. 3in. in length over buffers, after being loaded with ore at the 7000ft. level, will be hauled out of the mine in huge cages, so that, once the ore is put on wheels underground, it remains on the same wheels until tipped into surface ore bins some distance from the collar of the shaft. When the loaded cage arrives at the surface, a mechanical "pusher" ejects the 8-ton truck by shoving an empty truck behind it into the cage. The still loaded truck continues its course down a gravity track to the tippler bins, where its load is discharged over grizzly bars to eliminate the fines, which go straight to the mill by conveyor belt. The coarse ore is then conveyed in 40-ton hoppers to the sorting and crushing station at No. 2 shaft, whence it will be conveyed back to the crushing plant by locomotive haulage.

When a loaded cage has been raised to the transfer station on the seventeenth level, a mechanical "pusher" pushes an empty behind the full truck until the latter is lifted on to a traverse carriage on which it is carried to the other cage in the upper shaft section 60ft. westward. There another "pusher" shoves the full truck, which, in turn, pushes the empty one to another traverse carriage for conveyance to the return cage. The 8-ton truck is

then lifted the final 4500ft. to the surface, to be handled further as already described. The cages that convey the 8-ton trucks have upper decks that will hold fifty-five persons, and when the shift is lowered and raised the lower deck will accommodate another fifty-five, so that 110 persons can be raised or lowered at the same time. The cages will stop at all stations in the lower shaft in order to off-load men and materials for the different levels. The cages are of such great size that material and steel sent underground will be loaded into trucks at the surface to be run out of the cage at any desired level, thus saving the old delay caused by off-loading piecemeal and re-loading at each station level again for transfer to mine workings. Despite the huge depths from which the ore has to be hauled, the cost of the increased lift should be more than balanced by the saving in working costs gained through the concentration of ore by gravity passes from the huge area of mine workings lying above the thirty-third level.

Breakages of Rails.

An explanation has been advanced with regard to the splitting of rails on the electrified portion of the Natal main line, which involves some criticism of the design of the articulating joint between the two bogies of each locomotive. Opinions differ as to the amount of relative movement that should be allowed in this joint. In the design adopted for the South African locomotives, the adjacent ends of the two bogies are completely free to move in a vertical direction, but no relative lateral movement is possible. In the early part of last year, a considerable number of split rails was found on the main line, the majority being on the electrified section. The split developed along the bottom of the web, and mainly at points where the rails were bolted down to the sleepers. Usually, the trouble was confined to curves, and the cracks were on the outer side of the web. The matter was carefully investigated by representatives of the chief civil engineer and the chief mechanical engineer, and records were taken by a specially devised instrument of the horizontal deflections of the rail head caused by the passage of a set of three electric units and by one or two different steam engines. It appeared from the records that the deflection due to the leading axle of the trailing bogie of each electric unit was greater than that caused by any other axle on either electric or steam locomotives, and the splitting of the rail was ascribed to fatigue caused by the stress corresponding to the deflection. It also appeared from further tests that if the articulating joint between the bogies were slightly altered to permit of a small amount of relative lateral movement, the deflection and stress would be no greater than those experienced with steam engines or heavy coal trucks. The general conclusion was that the track, which was in any event rather light for the traffic to be carried, should be strengthened by laying rails of slightly greater weight and with the web strengthened at the base. It was decided not to proceed with the suggested modifications to the articulating joints, as it would have an adverse effect on the wear of the tires on the leading wheels of each locomotive unit.

Wagon Order for Britain.

The Railway Administration has placed an order with Vickers and Metropolitan Carriage Company, Ltd., for 500 four-wheeled open drop-sided steel wagons, 3ft. 6in. gauge, at an approximate cost of £100,000, f.o.b. Liverpool. The order is stated to have been placed on the merits of the price and delivery, against strong continental competition. In recent contracts placed with the successful company, deliveries have been effected well in advance of contract time.

An Automatic Telephone System.

The rapid increase in telephone requirements by the numerous departmental offices of the Cape Town municipality has led to the installation at the City Hall of an automatic branch exchange to which all telephones in the buildings and near-by annexes will be connected, together with the necessary manually-operated switchboard for dealing with incoming and outgoing calls between the automatic and the Post Office exchange. By arrangement with the Post Office Administration, the latter has ordered and installed the equipment in the City Hall, and work upon it is now completed. The equipment, which is of the Siemens type, and was supplied by the English Electric Company, Ltd., is arranged for an immediate capacity 140 extension lines, with an ultimate capacity 300 lines, but the exchange is so arranged as to permit of its increase, if found necessary, beyond 300 extensions. Thirty junctions between the manual board and the public exchange are provided, but these can be increased ultimately to fifty.

Incoming calls are dealt with by the P.B.X. telephonist, who completes the call by plugging into the jack directly associated with the called extension. Outgoing calls are dealt with either by the calling extension dialling "O" and being connected automatically to the public exchange, or by the calling extension dialling "9" and obtaining the services of the P.B.X. telephonist, who completes the connection. Since the telephonists are not on duty twenty-four hours per day, night service between certain telephones and the Post Office exchange is obtained by plugging their lines through direct to the latter on specified junctions during off-duty hours. These telephones thus have a definite Post Office exchange number outside ordinary office hours, and incoming calls to them are then dealt with by the public exchange operator. A complete power plant for the equipment is also installed in the City Hall. It consists of a duplicate set of secondary batteries, motor generator for battery charging, power switchboard, &c.

LOVERS of horses will be glad to hear that their use in railway services for collection and delivery purposes is increasing, despite the larger number of motor vehicles. At the end of 1927 there were 18,714 horses, an increase over 1926 of 270. The number of parcels and goods motor-driven vehicles increased during that period by 374 to 2875, but horse-drawn increased also by 162 to 32,500.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Holiday Influences.

PRACTICALLY the whole of this week has been given over to holiday making, and little business of any description has been done. Iron and steel works in the Midlands and Staffordshire have, in the majority of cases, been idle, there being no pressure of business on manufacturers' books to justify a resumption of activity at mid-week, as is sometimes the case. The weekly meeting in Birmingham was sparsely attended, and there was no serious attempt to do business. Consumers' early requirements were covered before the holiday break, and, as the next week or two will, as usual, be a very quiet business period, users of iron and steel can afford to put off purchases until another day. This they are doing. The continued rise in prices of continental iron and steel is affording satisfaction to local producers. The gap between native and foreign prices is now so narrow as to make it advisable for the consumer to buy the home product, especially if, as is now generally the case, he needs small supplies and early delivery.

Staffordshire Bar Iron.

The rollers of Staffordshire wrought iron are fairly well situated for orders, but no headway has been made this week, buyers having been off the market. In the marked bar department values are maintained at £12 per ton, and a little more business has of late come to makers of Crown quality iron at a figure in the neighbourhood of £10. Lancashire houses maintain their competition in this branch of the market. Prospects of business for local makers of nut and bolt and fencing bars is improving slowly, but continental prices have still a long lead. Belgian No. 3 iron has advanced further, being quoted this week £6 15s. to £6 17s. 6d. delivered in the Black Country. These figures are, however, still about £2 per ton lower than that at which district rollers are prepared to sell. Wrought iron gas tube strip is in moderate demand at £10 15s. upwards. Makers of tubes in this area are anticipating the use of increasing tonnages of this material.

Steel.

On the eve of the holidays a rather better demand for structural steel was reported, and inquiries circulated are, it is stated, likely to develop into actual orders very shortly. The reaffirming by native steel masters of recent selling rates and the continued high price of continental material should have an invigorating effect upon business. Angles are quoted at £7 17s. 6d., and ship plates at £8 12s. 6d., with boiler plates at £11. Steel hoops make £10 10s. at works. Steel bars have a range of from £7 7s. 6d. to as high as £7 17s. 6d., as against the new increased price of £6 17s. 6d. to £6 18s. demanded for imported bars. English and Welsh billets are on a competitive basis with foreign products. Belgian billets are difficult to obtain.

Galvanised Sheets.

In the galvanised sheet industry there is a fair amount of inquiry, and some of the Midland mills have good order books. A number of mills recommenced rolling on Wednesday, and others which have had an extended holiday will be able to make a good start on Monday. For 24 gauge corrugated sheets the basis is upheld at £13 7s. 6d. to £13 10s., but the extras for 28 gauge have been reduced by 5s. per ton. The new basis for 30 gauge is still hardly determinable, but is in the region of £17 5s.

Raw Iron.

Ironfounders before the holidays made some small purchases of pig iron for delivery after the vacation, but consumers are not departing from the policy of hand-to-mouth buying which has ruled for some time past. On 'Change in Birmingham to-day the orders placed were on a meagre scale, and were at late prices. Quotations are, however, regarded as nominal, and some shading would undoubtedly be done if business, in bulk, were available. Derbyshire No. 3 foundry is quoted round about £3 at furnaces, Northamptonshire £2 16s., and North Staffordshire £3 3s. Hematites are in poor request, as are forge qualities. No information is available as to the damping down or recommissioning of furnaces in this area. If stocks increase much more, however, some curtailment of output is almost certain.

Ironworks for Stoke.

Robert Hyde and Sons, Ltd., iron and steel-founders, of Abbeydale Foundry, Sheffield, and of Chesterfield, have, it is announced, acquired a site at Stoke-on-Trent, where was formerly the North Staffordshire Locomotive Works, and intend to transfer their Sheffield branch to that site. It is stated that the increasing output of the firm has necessitated the change, which will take place in a month's time. A number of skilled workers will be brought to Stoke, but all the unskilled workmen will be recruited locally. The firm specialises in axle-boxes for railways.

Space "Rationing" at Birmingham B.I.F.

The pressure on the stand space allocated for the heavy section of the British Industries Fair to be held in Birmingham next year has been such that, despite a further increase this year of 25,000 square feet to the available space, it has become necessary to "ration" many firms to the dimensions of stand space which the Birmingham Fair authorities consider they can use to the best economic advantage. Only space for displaying their goods and interviewing customers has been granted, no room being allowed merely for the purpose of ornament or ostentation. For three years in succession permanent extensions have been made to the Exhibition buildings, at a total constructional cost running into six figures. The great extension for the 1928 display of heavy goods and hardware brought the Fair in Birmingham up to the immense area of 400,000 square feet available for show purposes. Less than 10,000 square feet of space now remains to be allocated for the heavy section. To have reached such a position more than six months before the opening constitutes a notable record.

Black Country Miners' Wages.

The wages of miners in the South Staffordshire and East Worcestershire coalfield during the months of August, September, and October are to remain at the minimum rate of 40 per cent. on base rates. The accountants' ascertainment for the months of April, May, and June show that the percentage payable is 115·71 per cent. of base rates, as compared with 131 per cent. in the previous ascertainment. The deficiency in these three months amounted to £19,835, and there is now an accumulated deficiency of £51,922.

Coal Slump.

Trade conditions in the Cannock Chase coalfield continue at a low ebb, and the scarcity of orders is such that most of the pits in the district have been closed down during the whole of the week. Stocks at the pithead are somewhat smaller than they were, but there is no immediate prospect of a real improvement in demand, either for works or domestic fuel.

Exports from Birmingham to U.S.A.

Exports from the Birmingham consular district to the United States of America during the quarter ended June 30th totalled 2,155,887 dollars, an increase of 352,294 dollars, compared with the corresponding quarter of 1927. A singular feature of the trade, considering the city's predominant interest in metal manufactures, was that the largest individual export was golf balls. They amounted to 311,062 dollars, compared with 216,152 dollars a year ago. The export of needles improved to the extent of 7260 dollars, the total being 159,207 dollars. Steel sashes dropped from 71,223 dollars to 55,421 dollars. Pens totalled 83,833 dollars, against 69,040 dollars a year ago.

The Late Mr. E. C. R. Marks.

Midland engineers learned with much regret of the death last week of Mr. Edward Charles Robert Marks, the well-known Birmingham engineer. Mr. Marks, who had attained his sixty-first year, was an associate member of the Institution of Civil Engineers, and at one time a member of Council of the Institution of Mechanical Engineers. He took a leading part in establishing the Birmingham branch of the Institution of Mechanical Engineers, and was the first chairman of the branch. His early training as an engineer was obtained in the workshops of the Royal Arsenal, Woolwich. In 1889 he joined the firm of Marks and Clerk, consulting engineers and patent agents. In his early years Mr. Marks was a lecturer on engineering subjects at the Municipal Technical School, and he was also a writer of engineering text-books, which were valued by engineers of his generation. He was associated with his brother, Sir G. Croydon Marks, in a number of constructional engineering works, among which may be mentioned the Matlock cable tramway, the cliff railway at Bridgnorth, and the harbour extension at Padstock.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

The Industrial Outlook.

THE *Monthly Record* of the Manchester Chamber of Commerce, in the course of a general survey of industrial conditions, has the following concerning the position in the engineering industries:—"The report that Russia was placing substantial orders for textile machinery has been confirmed, the chairman of a Lancashire company stating at its annual meeting that a £500,000 order, for delivery within the next twelve months, has been placed with them by the Soviet Government, and that the order will probably be increased considerably later on. Several firms are making machinery for the artificial silk trade, which is developing rapidly, and there is a good deal of work in hand. For cotton spinning and weaving machinery, however, there is not much doing for the home trade, and the foreign demand for looms is not as active as it was a short time ago. Electrical engineers continue to be fairly well engaged, and constructional engineers have recently received important contracts. Cable-makers are likely to be busier than ever when the great electrical distribution schemes are a little more advanced, and some other sections of the engineering trade are well employed, although there are exceptions which are not unimportant."

Poor Industrial Call for Fuel.

Referring to conditions in the coal trade locally, the *Monthly Record* points out that industrial fuel has met with a poor demand during the past month owing to the prevalence of short-time in the cotton factory districts and the number of closed mills, including those concerned in the Nelson lock-out and some Oldham spinning mills which depended on Nelson trade. House coal had a rather better sale when cold winds prevailed, but little was used with the return of normal July weather, and some kinds of coal were 1s. a ton cheaper. Output was restricted under the "five-counties" scheme, but the supply was adequate, and spot lots could be had at less than the ordinary quotations.

Railway Electrification.

A start with the work of electrifying the railway line running between Manchester (London-road Station)

and Altrincham, popularly known locally as the Manchester-South Junction line, is to be made in the autumn. The route in question, which runs from the city to the suburbs on the fringe of Cheshire, is one of approximately nine miles, and an unofficial estimate places the cost of the scheme at something like £500,000. The scheme, however, will ultimately form only a portion of a larger scheme of suburban railway electrification, an outline of which was given in this column some months ago.

The Steam Rail-Car.

Test trips with the type of steam rail-car which it is intended to run shortly on the London and North-Eastern Railway lines in Lancashire, Cheshire and Derbyshire took place on Tuesday of this week between Glazebrook and Wigan and Glazebrook and St. Helens. These rail-cars are to be put into operation on a number of local lines primarily to meet the competition of the motor-omnibus. Accommodation is provided for sixty-four seated passengers and thirty standing.

New Liverpool-Manchester Road.

Referring at the quarterly meeting of the Lancashire County Council to the proposed new Liverpool-Manchester arterial road, Alderman Aspell, the chairman of the Main Roads Committee, said that it was hoped almost immediately to have an order from the Ministry of Transport which would let them enter upon the land and proceed with the work up to the point where the County Council had power now to go. Alderman Aspell said that there was a termination in Salford still to be defined, but in regard to that the County Council would probaby have to promote a Bill in Parliament to give them certain powers.

Non-ferrous Metals.

Another relatively uneventful week, influenced to some extent by the Bank Holiday, has been experienced on the non-ferrous metals markets. Consumers in the tin section, as well as the purely speculative interests, are operating none too freely on account of the uncertainty which continues to shroud the outlook for this metal. There has been talk this week of tin touching £250 a ton before the end of September, but current statistical pointers, whatever the market may be confronted with within the next few weeks, are by no means on the side of the "bulls." There has been a loss on the week, but it has been very slight, and much less than what one might have expected, in fact, of the substantial increase in the stocks of the metal in this country. The demand for copper has been of limited extent, although there has been a certain amount of buying for the cable-making industry. Prices have given way a little, but the loss on balance at the time of writing has been almost infinitesimal. Available supplies of lead are not too plentiful at the moment, and values show a continued upward tendency, quotations, for the third successive week, representing an improvement of about 5s. a ton. The ups and downs of the spelter section are not yet at an end, and on a distinctly quiet demand prices have more than lost the advance reported a week ago.

Iron and Steel.

In the absence of any important developments in the iron and steel markets here during the past week there is little fresh to report. To a large extent this is due to the Bank Holiday and its aftermath, for the markets have been poorly attended, and consumers, both of iron and steel, are showing comparatively little interest in buying just now. The problem as to whether or not there will be the usual autumn spurt in the demand for the metals is exercising the minds of sellers at the present time, but many of them are not too hopeful. Others, however, basing their views on the fact that for several months users have been operating on a strictly han1-to-mouth scale, are optimistic enough to look for some degree of improvement early next month. Prices, generally, are nominally unchanged on the week in the pig iron section, Staffordshire and Derbyshire brands being quoted at 67s. 6d. to 68s. per ton; Middlesbrough at 79s.; Scottish at about 87s. 6d.; and hematite at 82s., all for delivery Manchester or equal distance. British steel products are maintained at £8 17s. 6d. for frame plates; £8 12s. 6d. for general plates; £9 10s. to £9 15s. for boiler plates; £7 17s. 6d. for joists and sections; and £8 17s. 6d. for large diameter bars. A further stiffening in quoted rates for continental steel products for delivery to works in Lancashire is again indicated, and the margin between these and British materials, though still wide enough in many cases, is narrowing. Imported billets are quoted for delivery here at about £5 12s. 6d. per ton, with sheet bars at £5 12s. 6d. to £5 15s.; joists at £6 to £6 2s. 6d.; angles at £6 15s.; Siemens plates at £8 2s. 6d.; wire rods at £6 15s. to £6 17s. 6d.; and bar iron at £6 16s. per ton.

The Late Mr. George Pool Gass.

Mr. George Pool Gass, whose death occurred at his home, the Hollins, Bolton, on the 30th ult., after a comparatively short illness, was well known and highly respected in engineering circles in Lancashire. He began his education at Bolton High School, and won the Ashbury Exhibition at Victoria University, Manchester. After serving his apprenticeship at the Atlas Foundry, Bolton, that business was taken over by Mr. Gass and his brothers, Mr. William S. Gass—President of the Manchester Association of Engineers—Mr. Thomas J. Gass and their sister, Miss Gass, about forty years ago. The title of the firm became Entwisle and Gass, and under the new ownership the business developed steadily, its chief products being bleaching machinery and plants for the manufacture of plate-glass, and for the production of rubber goods. In 1919 Entwisle and Gass purchased from Jackson and Brothers, Ltd., Wharf Foundry, Bolton, and later acquired the Clyne Engineering Company, Manchester. Mr. George Gass was an active member of the Bolton Chamber of Commerce, was on the Executive Committee of the Bolton Engineering Employers' Association, and was a member of the Manchester Association of Engineers. He was a man of much personal charm, unassuming and kind-hearted, and his death in his sixty-fifth year will be lamented by a very wide circle of friends in Bolton and Manchester.

BARROW-IN-FURNESS.

Hematite.

This is a holiday week and, as a result, the amount of business being done is negligible. The furnaces are still producing, and, of course, a fair amount is going into stock, as orders do not come up to the tonnage produced. Customers are still confining their orders to immediate requirements. There are some who are inclined to think that there will be an improvement in the autumn, and who point out that makers would not continue to accumulate stock unless there was this prospect. Perhaps in a month's time it will be possible to judge as to the trend of trade. The re-starting of the steel departments will certainly help to absorb the iron production and enable some of the producers to sell from stock. The iron ore trade is only moderate in view of the state of the local iron trade. Not much is going out of the district. The steel trade has been on the quiet side, but there is some hope of production now. The works at Barrow are being prepared to start on rails, and the Siemens furnaces have been got ready. At Workington a start will probably be made towards the end of the month. This is good news for the district, for there has been little work done in the steel departments for the past few months.

SHEFFIELD.

(From our own Correspondent.)

Holiday Influence.

AUGUST is always a quiet month for the heavy iron and steel industries, and this week has seen an almost complete absence of buying. There was some rush at the end of last week to get important work cleared off as far as possible, but since then conditions have been extremely quiet. The open-hearth furnaces have continued working throughout the holidays, and it is hoped that upon the general resumption in the associated departments there will be a sufficiently large accumulation of orders to give a better run of work than has been possible during the last month or two. The rolling mills are not finding it an easy matter to execute their work on a profitable basis, and orders generally are still for small lots. Steel buyers continue to show a preference for basic material, the call for acid steel being distinctly poor. The heavy engineering works are rather indifferent buyers, but there is a good deal of activity in the medium and light branches. In fact, some of these shops are literally "pulled out" with orders, notably in connection with electrical contracts which have kept the plants busy for many months past. Departments producing special-quality steel are also busy, and at the present time there is an exceptionally large number of inquiries about for stainless steels.

Lincolnshire Steel Trade.

Encouraging reports are to hand concerning the basic steel trade of North Lincolnshire. The Redbourne Hill Works at Scunthorpe, which have been idle for nearly four years, are to be gradually recommissioned. The coke ovens there are already working, and one blast-furnace is to be restarted next month and a second one in November. The management hopes to get the steel plant running early in December. There are at Redbourne Hill four open-hearth 60-ton basic furnaces and a mixer, and more than 1000 tons of ingots can be turned out by the plant each week. A good deal of activity is also noticeable in the other steel works in North Lincolnshire, which is stated to be more favourably placed than any other steel area in the country.

Cutlery and Plate.

Neither the cutlery nor the plate trade presents any particularly cheerful feature. Reports to hand from the big holiday centres indicate that the seasonal trade this year will be exceptionally poor. In addition, the general trend of home trade is downwards, and conditions in the Sheffield works would be very bad were it not for a useful lot of contracts for hotel and shipping purposes, and for the improved buying from the Colonies, where good-quality cutlery and cased goods are mostly favoured. New Zealand and Canada are buying much better than they were, but Sheffield firms are finding that competition is becoming considerably keener in the important Australian market. It is not, however, all the factories by a long way that are being kept anything like busy. Much short time is being worked, and the August holiday was welcomed rather than otherwise. Excellent headway continues to be made in the production of safety razor blades, and some steel firms are also booking a nice lot of orders for this class of steel for export.

Railway Contracts.

Although the general level of steel buying for use in connection with railway work is disappointing, chiefly in the matter of axles and tires, contracts for complete rolling stock continue to be placed, either directly in this city or with firms which have working arrangements with large Sheffield and district concerns. It is announced this week that Cammell Laird and Co., Ltd., has received an order from the Sudan Government Railway for fifty 30-ton open bogie goods wagons. The Leeds Forge Company, a subsidiary undertaking of Cammell Lairds, has also received a contract for the Tanganyika Railways for twenty bogie covered goods wagons. Clayton Wagons, Ltd., of Lincoln, has received a contract from the same railways for the building of eight four-wheeled brake vans.

Mining News.

Some time ago I drew attention to the amalgamation of the Aston Company and Beighton Ovens, Ltd., with the old-established Sheffield Coal Company, Ltd., the scheme of amalgamation having been carried out with the sanction of the Railway and Canal Commissioners. Reference to this development was made by Mr. Henry Reed, chairman of the Sheffield Coal Company, at the annual meeting. He mentioned that as a consequence of this amalgamation, they had a coalfield practically in a ringed fence, with resources sufficient to yield a very substantial output for the remainder of this century. When the scheme of development, now in hand, was completed, given normal conditions, they hoped to be able to produce 1¼ million tons per annum, and the output of coke and by-products could be more than doubled. The Railway and Canal Commission has adjourned until next term an application by the Sherwood Colliery Company, Ltd., of Mansfield, for directions with regard to the working of 185 acres of land for coal, situated in Mansfield and Mansfield Woodhouse. A deputation from the Hoyland Urban District Council has waited upon Mr. William Hay, general manager of Newton, Chambers and Co., Ltd., as to the prospects of reopening the Hoyland Silkstone Colliery which was closed some few months ago. This colliery is the principal contributor to local rates, and it was bad news for the deputation to be told definitely that the pit will not work this year and will probably not reopen in 1929.

Large Contract for Derby.

A contract for £200,000 in connection with the remodelling of the Metropolitan Railway power station, Neasden, has been placed with International Combustion, Ltd., of Derby. A pulverised fuel system is to be substituted for the present twenty stoker-fired boilers.

Water Scheme Completed.

Mexborough, a populous mining town near Sheffield, has at last solved its long-standing water problem by the opening of the Ludwell supply, augmenting the formerly inadequate resources by about 250,000 gallons a day. The negotiations to acquire the Ludwell Springs were opened in 1926, and after some delay the sanction of the Ministry of Health was obtained last March. When completed, the scheme will have cost £8340.

NORTH OF ENGLAND.

(From our own Correspondent.)

Shipbuilding Industry.

THE recent placing of several orders for new tonnage and the fact that a number of inquiries are still circulating have given rise to a more optimistic view regarding the outlook in the shipbuilding industry on the North-East Coast. There is, however, still a long way to go before the shipyards assume a satisfactory position. The year commenced with a fair supply of work in hand, but construction has been remarkably rapid, and orders have not been forthcoming to replace the vessels completed. For more than two months no fresh orders were placed, with the result that several yards became practically depleted of work. The situation was probably worse on the Wear, but on the Tyne also large numbers of men had to be dispensed with. There is little doubt that the Budget proposals, in regard to the relief of the heavy industries, influenced shipowners in withholding contracts in the hope that they would reap some benefit. Many are now convinced, however, that the policy of waiting for the period at which the proposals will take effect is not the best under the circumstances, with the result that there has been a more marked disposition to give out new work. Contracts for twenty-one new vessels have been placed on the North-East Coast during the past two months, and of these, no fewer than fifteen are for foreign owners, Swedish and French predominating. It is stated that the Swedish yards are so full of work that shipowners cannot be promised the delivery required, and they have been compelled to turn to the British yards. At the same time, the situation indicates that British shipbuilders are not altogether unsuccessful in holding their own against foreign competition, which is now an important factor in the shipbuilding industry.

Iron and Steel Trade Gloom.

The iron and steel trade in this area appears to have entered upon a period of settled gloom. Business is usually slack at this period of the year, but the depression has seldom been so acute. Prospects continue discouraging. In some branches, further curtailment of output is threatened as the result of the dearth of work. Much anxiety is felt concerning the near future, but there is still hope of movement in the direction of trade development next month, when in ordinary course customers should come forward to negotiate for forward supplies. Meanwhile, manufacturers experience much difficulty in keeping certain departments employed. Fairly substantial contracts for some descriptions of material have yet to be run off, and a resumption is expected shortly on orders, the execution of which was delayed. At the same time, the general situation keeps unsatisfactory, the total volume of business passing being on quite a disappointing scale, even for this period of the year.

Cleveland Iron Trade.

There is little change in the condition of the Cleveland pig iron trade. Consumers persistently seek price concessions, and are buying very sparingly, while producers are emphatic in their declaration that quotations cannot be reduced, as they are already on an unprofitable basis. Products of other home areas are competing successfully in markets hitherto supplied from this district. Needs of local foundries and steel works, together with delivery demands of other running contracts, almost absorb the restricted output of Cleveland iron, and makers report that they are managing to dispose fairly well of the small surplus of iron available for the open market. Merchants and consumers, however, are strongly of opinion that expansion of business can be effected only by

price reductions. No. 1 Cleveland foundry iron is 68s. 6d.; No. 3 G.M.B., 66s.; No. 4 foundry, 65s.; No. 4 forge, 64s. 6d.

Hematite Pig Iron.

East Coast hematite pig iron is in abundant supply, notwithstanding the small production, and makers are hampered by rather heavy stocks. There is no fixed price arrangement, and makers are accepting low and unremunerative figures to keep their furnaces going. Buyers state that they can readily place the few home and export orders they have to give out at the equivalent of 68s. for mixed numbers, though there are makers who quote on the basis of as much as 70s. The small demand is almost entirely for iron made to special analysis to suit particular requirements of customers.

Ironmaking Materials.

Consumers of foreign ore show no disposition to enter into new contracts, even though merchants confidently predict an upward movement in prices. Best Rubio ore is fully 22s. 6d. c.i.f. Tees. Coke is fairly well sold for export over the next few months, but home users are as disinclined as ever to negotiate at all extensively for supplies. Durham good average blast-furnace qualities remain at 17s. 6d. to 17s. 9d. delivered to works in this district.

Manufactured Iron and Steel.

Output in some branches of the manufactured iron and steel trade is still on a heavy scale, but in other departments new orders are urgently needed. Purchases of continental semi-finished steel are not extensive, the situation abroad being regarded as doubtful. Sales of finished steel are not readily arranged, but some export inquiry is reported. There are no quotation changes to record.

The Coal Trade.

The coal trade has been dominated this week by holiday influences, and operations have been on a very small scale. Prospects for the next week or two are not promising, as, except for a little inquiry in certain Durham brands of coal, buyers are not showing much interest. Producers are trusting to an improved trade at the beginning of September, but as the effect of the Government's relief scheme on the rail coal charges is still uncertain, buyers show no inclination yet to deal forward. Prompt requirements, too, are light, and the collieries are experiencing a very slack time. The Northumberland pits especially have only an irregular trade, owing to the lack of inquiry for steam coal, but late prices are being steadily upheld. Best qualities are quoted at 13s. 6d., and secondary at 12s. On the Durham side, coking coal is fairly well sold, but the difficulty of getting prompt tonnage acts adversely on the position. Gas coal and bunkers are only quiet, but show a little improved outlook. The market is firm for all makes of coke, but shippers are unable to secure tonnage of any volume, and consequently considerable orders are being held up, and stocks increase accordingly. Prices are steadily held, gas coke being 20s. to 20s. 6d.; patent oven coke, 18s. to 19s.; special cokes, 22s. to 24s.; beehive coke, 23s. to 27s.

SCOTLAND.

(From our own Correspondent.)

Shipbuilding.

OWING in a measure to the holidays, tonnage launched from Clyde shipyards during July was the second lowest for this year to date. Thirteen vessels of 38,725 tons were launched. On the other hand, the figures for this year to date, amounting to 127 vessels, of 342,079 tons, are double those recorded in the same period in 1927 or 1926. One vessel was responsible for almost one-third of the July output—the "Shropshire," light cruiser, 10,000 tons. Also included in the output returns are five vessels of over 4000 tons each, as follows:—"Burdwan," cargo, 6100 tons, built for the Hain Steamship Company, Ltd., Cardiff; "Designer," cargo, 5880 tons, for Messrs. T. and J. Harrison, Liverpool; "Bellorado," cargo, 4580 tons, for Messrs. Bell Brothers, Glasgow; "Belybryn," cargo, 4500 tons, for British owners; and the "Blairmore," cargo, 4300 tons, for Messrs. Geo. Nisbet and Co., Glasgow. Contracts announced during July included the following:—A passenger and fruit-carrying vessel of 400ft. in length for Elders and Fyffes, Ltd., London, and two motor vessels, 200ft. each in length, for the Argentine Navigation Company, Ltd., London. While the output figures would appear to indicate a good measure of prosperity in the industry, statistics dealing with work on hand at the shipyards tell a different tale, the decrease in tonnage over the past four months being about 100,000 tons. Empty berths are being added to and there is no indication of an early improvement in the rate of bookings of new contracts. Consequently, the outlook is far from satisfactory.

Steel.

The position in the steel trade generally is not particularly encouraging. Orders booked during the holidays do not bulk largely, and immediate prospects are dull. On the other hand, producers are more hopeful in view of the sustained upward trend of continental prices, and also the freight concessions under the Government's de-rating plans. Meanwhile, heavy steel cannot be termed active. Sheet makers and tube makers are comparatively well placed, however. The former will probably be kept busy for some months ahead, while the latter have good orders on hand for most classes of tubes. Prices are unchanged.

Iron.

The bar iron works have not improved their position. Re-rolled steel bars have been a shade busier, but the orders secured do not in any sense compensate for the lack of business in the bar iron trade. Prices are unchanged.

Pig Iron.

The pig iron market is without any fresh feature. Outputs are extremely restricted, but there is no indication of an immediate addition being made to the furnaces in blast, owing to the state of the demand and the poor prices realised.

Exports and Imports.

During the past week imports included 4000 tons of iron ore, 3000 tons of iron and steel products, and 1500 tons of pyrites. Exports of steel and iron amounted to 1400 tons and shipments of pig iron 817 tons.

Coal.

The export market continues quiet, with prices maintained, as collieries are busily engaged overtaking orders accumulated during the holidays, and have their outputs arranged for over the next two or three weeks. In all districts large coals are steady, and washed nuts are scarce and firmer in price. Aggregate shipments during the past week amounted to 205,307 tons, against 204,689 tons in the preceding week and 215,592 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

OWING to the holidays the conditions in the steam coal trade have been of a featureless character during the past week or so. There was not much business being done immediately before the vacation, and it will be next week before settled conditions prevail. It cannot be said that there was any rush for supplies of coal before the holidays. Shipments last week came to 471,192 tons, as compared with 454,550 tons the previous week. The amount of tonnage at the disposal of the collieries was rather disappointing, and when Saturday came the records showed that taking all the docks together there were no less than fifty-four idle tipping appliances, which is very nearly a record. Of course, it was expected that there would be a big exodus of tonnage, both merchants and shipowners being anxious to get the tonnage away rather than have it detained in dock all over the holidays, which meant the best part of a week. Hopes are entertained that more activity in shipments will be experienced after the vacation. Certainly most of the collieries should have a fair amount of tonnage ready for them as the result of fresh arrivals, and the returns indicate that recent chartering have been slightly brisker. No one expects, however, that the position will have so far improved as to place the bulk of the collieries in anything like a comfortable situation. While there has been some expansion in orders the fact remains that trade is well below what is required. One contract which has attracted a considerable amount of attention is that for the supply of 140,000 tons of locomotive coals for the Egyptian State Railways to be delivered at Alexandria over the next three months. Tenders have not been confined to coals from this district, and for this reason more than ordinary competition is looked for, although this at all times has been very keen. Tenders were due to be opened at Cairo on the 7th inst. and have to hold good for a period of ten days. On the last occasion that the railways bought the lowest price which was accepted for Welsh coals was 26s. 8d. per ton c.i.f., and it is not expected that the lowest figure put in for the present requirements of the railways will be much, if any, higher than the last.

Amalgamation of Collieries.

Reference was made last week to developments in the anthracite area of South Wales. Since then the official announcement has been made that a provisional agreement has been signed for the acquisition by the Amalgamated Anthracite Collieries, Ltd., of Henderson's Welsh Anthracite Collieries, Ltd., and the Welsh Anthracite Collieries, Ltd., these latter concerns being known in coal trade circles as the Henderson and Beddoe-Rees groups respectively. The result is that the Amalgamated Anthracite Collieries, Ltd., of which Lord Melchett is chairman, will control over 80 per cent. of the output of anthracite coal in South Wales. As a matter of fact, the only group of any real importance now outside is that known as the Evans-Bevan group, and it is expected that there will be some agreement with it as regards prices. It is stated that the capital of the new combine will not be far short of £14,000,000, and that the Henderson and Beddoe-Rees group will take the bulk of their consideration if not all in shares. Turning to the steam coal area, there are prospective developments in the way of merging that have caused some consternation in coal trade circles. Negotiations are so far in the early stage, but something more definite is expected to be heard of them in the course of the next week or two. It is not long since the Powell Duffryn Steam Coal Company acquired the Lewis Merthyr undertaking and the Great Western Colliery Company, and made a working arrangement with the Cardiff Collieries, Ltd. The combination of interests now foreshadowed is that of the Powell Duffryn undertaking with the Consolidated Cambrian, Ltd., and D. Davis and Sons, Ltd. The Consolidated Cambrian, Ltd., controls the Cambrian, Glamorgan, Naval and Britannic Merthyr Colliery companies, with an output in normal conditions of 2,500,000 tons per annum, while D. Davis and Sons, Ltd., own eight pits at Ferndale and Tylorstown, which can produce 1,500,000 tons per annum of the best Welsh steam coals. It is not as yet known what form the combine will take, but if it comes under the control of the Powell Duffryn concern it will then have the marketing of round about 12,000,000 tons per annum. There are also rumours of further developments, as it is stated in coal circles that Cory Brothers and Co., Ltd., have provisionally purchased the property of Nixon's Navigation Co., Ltd., but of this no official information is forthcoming.

Coal Contract.

Information now to hand shows that the lowest prices tendered for the Egyptian State Railways contract are 26s. 9d. c.i.f. for Welsh coal, 22s. 4d. c.i.f. for Northumberland coals, 24s. c.i.f. for Yorkshire coals, and 27s. 6d. c.i.f. for Rhenish-Westphalian coals. In the case of the tenders for Welsh coals the lowest price of 26s. 9d. c.i.f. Alexandria is for Russell's Tillery large, but for the Egyptian State Railways list of Welsh coals the best price is 27s. 1d., put in by two firms, viz., T. Beynon and Co., Ltd., and Lindsay, Blee and Co. The actual placing of the contract has not yet been done.

Tin-plate Industry.

Reports were current immediately before the holidays of a better demand for supplies of tin-plates. On Friday last the special Joint Committee appointed by the Joint Industrial Council met to consider the men's claim for the revision of the present sliding scale agreement which was introduced in 1920, and is based on the selling price of tin-plate bars, which is the staple commodity of tin-plate, but it has not operated for several years owing to the price of bars declining below the zero of the scale. Consequently it has been necessary to meet the position which arose by the granting of *ex-gratia* bonuses. The men are mostly in favour of the basis in future being the price of tin-plates, and it is understood that this suggestion which the employers said a year ago was impracticable was again put forward. When the meeting eventually adjourned it was reported that a feeling prevailed that a solution of the problem acceptable to both sides was possible. West Wales tin-plate boilermen met also on Saturday last and decided to put forward an application for an advance in wages, viz., for a flat rate of 15s. per shift. These men are paid 6s. 2d. per shift, plus a small bonus, which makes a weekly wage of about £2 14s., and they ask that their wage rate should be based on output. These terms have already been conceded to the furnacemen in the industry. Mr. H. C. Thomas, the secretary of the Welsh Plate and Sheet Manufacturers' Association, left Swansea last Friday for a fortnight at Toronto, where the Association has an exhibit at the Canadian Trades Fair. He is being accompanied by Sir Edgar Jones, and while in Canada they will discuss with the authorities the question of tariffs on tin-plates and with Canadian canners the subject of giving preference to Welsh tin-plates.

A Belgian Decree.

The Vice-consul for Belgium at Cardiff, Mr. L. Downing, has been officially informed from Brussels that a Royal Decree dated July 12th last compels all importers of coal, coke and briquettes to supply particulars of the lots imported before their arrival. This measure is stated to be purely for statistical purposes, and does not contain any idea of Government control or license, as has been suggested in some quarters.

Wagon Hire.

The South Wales Wagon Owners' Association recently decided to increase the rate of hire from 4s. to 5s. per wagon per week to operate as from the 13th inst. This Association was formed two months ago for the purposes of protecting the interests of wagon owners and to decide upon uniform rates of hire from time to time. Before the formation of this organisation there was much inter-competition between owners, with the result that rates fell as low as 3s. 3d. per week, but since that time rates have advanced as the result of the co-operative policy adopted.

Current Business.

Business in steam coals has virtually been at a standstill during the past week, owing to the holidays. Prices have not moved for the reason that values all round are at the minimum figures. Pitwood has ruled easier, consequent upon the reduced working at the pits and the lessened demand, prices being about 27s.

Miners for Canada.

In connection with the Government scheme designed to enable the unemployed to secure work in Canada as harvesters, there was a big rush on Monday and Tuesday of volunteers. Well over 1500 have come forward showing eagerness to take advantage of the offer. At the Labour Exchanges at Cardiff on Monday young unemployed miners formed queues at nine in the morning.

CATALOGUES.

KRYN AND LAHY (1928), Ltd., Letchworth, Herts.—A brochure illustrating carbon steel castings for all purposes and industries.

FOAMITE FIREFOAM, Ltd., 55, Great Marlborough-street, W. 1.—"Safeguarding Your Property," a booklet on Foamite fire protection apparatus.

GENT AND CO., Ltd., Faraday Works, Leicester.—Book 5 on the "Pul-syn-etic" system of electric impulse clocks and time discipline apparatus.

SILICA COKE OVEN AND MACHINERY, Ltd., Aldwych House, Aldwych, W.C. 3.—Bulletin No. 3 of the new Otto regenerative coke oven of the compound type.

LEA RECORDER COMPANY, Ltd., 28, Deansgate, Manchester.—Booklet Q 16, on the measurement of water and other liquids over weirs and notches in connection with mining work.

THE BRITISH THOMSON-HOUSTON COMPANY, Ltd., Rugby.—Descriptive list No. 4506, "Oxide Film Lightning Arresters—Cell Type," and No. 5185, "Unbreakable Grid Resistances."

UNITED WATER SOFTENERS, Ltd., Aldwych House, London, W.C. 2.—Illustrated booklet, entitled "Safe Drinking Water," in which is described the preparation of Chloramine solution, in bottles of the "Sparklet" type, for the sterilisation of small bodies of polluted water.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	19/- to 21/-
(1) Spanish	19/- to 21/-
(1) N. African	19/- to 21/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	22/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 14 0	—
No. 1 Foundry	3 15 0 to 3 16 0	—
No. 3 Foundry	3 11 0	—
N.E. COAST—		
Hematite Mixed Nos.	3 8 0	3 8 0
No. 1	3 8 6	3 8 6
Cleveland—		
No. 1	3 8 6	3 8 6
Silicious Iron	3 8 6	3 8 6
No. 3 G.M.B.	3 6 0	3 6 0
No. 4 Foundry	3 5 0	3 5 0
No. 4 Forge	3 4 6	3 4 6
Mottled	3 4 0	3 4 0
White	3 4 0	3 4 0
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	—	—
,, ,, Foundry	3 2 6	—
(3) Northampton—		
Foundry No. 3	2 15 0 to 2 17 0	—
Forge	2 13 6	—
(3) Derbyshire—		
No. 3 Foundry	3 0 0 to 3 1 0	—
Forge	2 18 0	—
(3) Lincolnshire—		
No. 3 Foundry	3 1 0	—
No. 4 Forge	2 18 6	—
Basic	3 0 0	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 2 6 (a); 4 5 6 (b); 4 9 0 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 5 0	—
Common Bars	10 5 0	—
Best Bars	10 15 0	—
LANCS.—		
Crown Bars	10 0 0	—
Second Quality Bars	9 10 0	—
Hoops	13 0 0	—
S. YORKS.—		
Crown Bars	10 10 0	—
Best Bars	11 0 0	—
Hoops	12 10 0	—
MIDLANDS—		
Crown Bars	9 5 0 to 10 0 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 17 6 to 9 0 0	—
Gas Tube Strip	10 15 0 to 10 17 6	—

STEEL. (d)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	10 10 0	10 10 0
Ship Plates, ¼in. and up	8 7 6	7 12 6
Sections	7 17 6	7 2 6
Steel Sheets, ¼in.	8 12 6	8 10 0
Sheets (Gal.Cor. 24 B.G.)	13 7 6 to 13 12 6	13 7 6

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 7 6	—
Angles	7 17 6	—
Boiler Plates	12 15 0	—
Joists	7 17 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	7 12 6	—
Soft Billets	6 15 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	7 10 0 to 10 0 0	—
MANCHESTER—		
Bars (Round)	8 17 6	—
,, (Small Round)	7 15 0	—
Hoops (Baling)	10 0 0	9 15 0
,, (Soft Steel)	9 0 0	8 15 0
Plates	8 12 6	—
,, (Lancs. Boiler)	9 10 0 to 9 15 0	—
SHEFFIELD—		
Siemens Acid Billets	10 0 0	—
Hard Basic	7 2 6 to 7 12 6	—
Intermediate Basic	7 0 0	—
Soft Basic	6 5 0 to 6 7 6	—
Hoops	9 0 0	—
Soft Wire Rods	7 5 0 to 7 10 0	—
MIDLANDS—		
Small Rolled Bars	7 7 6 to 8 0 0	—
Billets and Sheet Bars	6 1 6	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	13 7 6 to 13 10 0	—
Angles	7 17 6	—
Joists	7 17 6	—
Tees	8 17 6	—
Bridge and Tank Plates	8 12 6	—
Boiler Plates	11 0 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	18/3
Block Tin (cash)	214 0 0
,, (three months)	213 5 0
Copper (cash)	62 13 9
,, (three months)	63 2 6
Spanish Lead (cash)	20 18 9
,, (three months)	21 2 6
Spelter (cash)	25 0 0
,, (three months)	24 17 6
MANCHESTER—	
Copper, Best Selected Ingots	67 0 0
,, Electrolytic	69 10 0
,, Strong Sheets	94 0 0
,, Tubes (Basis Price), lb.	0 1 1½
Brass Tubes (Basis Price), lb.	0 1 0
,, Condenser, lb.	0 1 2
Lead, English	22 15 0
,, Foreign	21 10 0
Spelter	25 0 0
Aluminium (per ton)	£107

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/7 per lb.	
Ferro Tungsten	1/3 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£21 0 0	7/6
,, ,, 6 p.c. to 8 p.c. ,,	£20 10 0	7/-
,, ,, 8 p.c. to 10 p.c. ,,	£20 0 0	6/-
,, ,, Specially refined		
,, ,, Max. 2 p.c. carbon	£33 0 0	12/-
,, ,, ,, 1 p.c. carbon	£39 0 0	15/-
,, ,, ,, 0·70 p.c. carbon	£44 0 0	17/-
,, ,, ,, carbon free	1/2 per lb.	
Metallic Chromium	2/8 per lb.	
Ferro Manganese (per ton)	£13 15 0 for home; £13 10 0 for export	
,, Silicon, 45 p.c. to 50 p.c.	£12 5 0 scale 5/- per unit	
,, ,, 75 p.c.	£19 0 0 scale 6/- per unit	
,, Vanadium	14/3 per lb.	
,, Molybdenum	4/3 per lb.	
,, Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£170 to £175	
Ferro-Cobalt	9/- per lb.	

FUELS.

SCOTLAND.
(*Prices not stable.*)

	Export
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	13/9
,, ,, Ell	14/3 to 14/6
,, ,, Splint	16/- to 17/-
,, ,, Trebles	13/3
,, ,, Doubles	13/-
,, ,, Singles	12/-
AYRSHIRE—	
(f.o.b. Ports)—Steam	13/6
,, ,, Jewel	15/6
,, ,, Trebles	13/6
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	11/- to 12/9
Screened Navigation	18/-
Trebles	13/6 to 14/-
Doubles	13/6 to 13/9
Singles	12/6
LOTHIANS—	
(f.o.b. Leith)—Best Steam	12/3
Secondary Steam	11/9
Trebles	13/6
Doubles	13/3
Singles	12/6

ENGLAND.

(8) N.W. COAST—	
Steams	24/- to 25/-
Household	37/6 to 50/-
Coke	22/6 to 23/6
NORTHUMBERLAND—	
Best Steams	13/3 to 13/6
Second Steams	11/9 to 12/-
Steam Smalls	9/- to 9/6
Unscreened	11/9 to 12/-
Household	21/- to 27/-
DURHAM—	
Best Gas	15/-
Second	13/3 to 13/9
Household	21/- to 27/-
Foundry Coke	18/3 to 19/-
SHEFFIELD—	Inland.
Best Hand-picked Branch	26/- to 27/6 —
Derbyshire Best Bright House	19/6 to 20/6 —
Best House Coal	18/6 to 20/- —
Screened House Coal	16/- to 17/- —
,, ,, Nuts	14/- to 15/6 —
Yorkshire Hards	14/- to 16/- —
Derbyshire Hards	14/- to 16/- —
Rough Slacks	8/6 to 9/6 —
Nutty Slacks	5/- to 6/- —
Smalls	3/- to 4/6 —
Blast-furnace Coke (Inland)	13/- at ovens —
Furnace and Foundry Coke (Export), f.o.b.	18/- to 19/6

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	19/3 to 19/6
Second Smokeless Large	18/- to 19/-
Best Dry Large	18/- to 18/6
Ordinary Dry Large	17/3 to 17/9
Best Black Vein Large	17/6 to 17/9
Western Valley Large	17/- to 17/3
Best Eastern Valley Large	16/6 to 17/3
Ordinary Eastern Valley Large	16/3 to 16/6
Best Steam Smalls	12/6 to 12/9
Ordinary Smalls	10/6 to 12/-
Washed Nuts	16/6 to 18/-
No. 3 Rhondda Large	19/6 to 20/-
,, ,, Smalls	14/- to 14/6
No. 2 ,, Large	16/- to 16/6
,, ,, Through	14/6 to 15/6
,, ,, Smalls	12/- to 13/-
Foundry Coke (export)	27/- to 36/-
Furnace Coke (export)	20/- to 20/6
Patent Fuel	21/- to 22/-
Pitwood (ex ship)	27/6 to 27/9
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	34/- to 35/-
Seconds	24/6 to 27/-
Red Vein	20/6 to 27/-
Machine-made Cobbles	40/- to 43/-
Nuts	35/- to 43/-
Beans	23/6 to 26/-
Peas	18/- to 19/-
Breaker Duff	8/- to 8/3
Rubbly Culm	12/- to 12/6
Steam Coals:	
Large	17/6 to 18/6
Seconds	16/- to 17/-
Smalls	10/- to 12/6
Cargo Through	15/- to 16/-

(1) Delivered. (2) Net Makers' Works. (3) f.o.t. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. (d) Rebate 12/6 joists and 10/- all other materials if home consumers confine purchases solely to British products.

French Engineering Notes.

(*From our own Correspondent in Paris.*)

The Steel Pact.

THE situation in the iron and steel industry is not all that could be desired, but in the opinion of French producers it would certainly be worse if it were not for the operation of the Steel Union. That body has passed through troublous times, and a great deal of tact has had to be exercised to prevent conflicting interests from imperilling its future. Whenever the existence of the Union appeared to be threatened there was an alarming slump in the steel trade, but the situation righted itself immediately it was understood that the difficulties had been cleared away. It is therefore recognised that the Steel Pact must be preserved. When the capacity of production is so much in excess of consumption it is obvious that there can be no hope for the trade unless the production is kept somewhere within the limits of requirements. So long as that is done prices remain stable. Nevertheless, the conditions of trade undergo a constant and often considerable variation, and the operations of the Steel Union appear, therefore, to affect some producing countries more than others, the result being that there have been claims for higher quotas or for reductions of indemnities imposed for surplus production. It became evident that it was no longer possible to continue modifying the clauses of the Pact in order to meet special conditions arising out of fluctuations of the home and export trade. At the last meeting in Dusseldorf a Committee was appointed to investigate the situation and settle upon some more rational basis which would give satisfaction to all the producing countries. As the result of the Committee's report some changes have been made in the situation of Central European producers, and the most important reform is a modification of the penalty system for excess of production. At first it was 4 dollars for every ton above the quota, and in some cases this was subsequently reduced to 1 dollar. It has now been decided to fix a progressive penalty of 1 dollar a ton, for a surplus production of not more than 7½ per cent. of the quota, up to 4 dollars a ton for more than 10 per cent. It has been found necessary to effect a readjustment by means of concessions in order to give a sound and permanent basis to the Steel Pact, the existence of which is regarded as essential to the existence of the continental steel industry in its struggle against Anglo-American competition. For some time past there has been a growing impression in France and elsewhere that steel producers in Great Britain and the United States are preparing to make a formidable bid for the world's markets.

Water "Verdunisation."

During his recent visit to Carcassonne the President of the Republic put into service a works which has been installed at Maquens for the "verdunisation" of the water from the river Aude before being distributed to the city. This process consisted originally in the addition of infinitesimal doses of chlorine, so small as to be measured by a minute fraction of a gramme of chlorine to a considerable volume of water. The method was introduced by M. Philippe Buneau-Varilla at Verdun during the war, whence the name, and remarkable reports were made by well-known bacteriologists upon the results obtained with experimental plants at Rheims and elsewhere, while at Carcassonne it was declared that since employing this method of sterilising the water from the river Aude there had been no recurrence of the periodical epidemics of typhoid fever which raised the mortality returns to an alarming figure. Nevertheless, a description of the Maquens installation suggests that the "verdunisation" process does not rely upon such minute doses as before. There is, first, a very efficient filtering plant, and the water is then sterilised by the action of chlorine "in regular and small doses and thoroughly mixed by a churning of the water." This differs from the original method, and the doses have apparently been increased, so that there may not be such a vast difference after all between this system and the ordinary processes of sterilising water with chlorine.

Metal Railway Coaches.

The derailment of a train at Le Mans Station whereby two postal vans and a passenger coach immediately behind the tender were telescoped, involving the loss of six lives and injuries to fifteen passengers, has been followed by an order to the railway companies to proceed at once with the replacing of all the old postal vans with metallic vehicles designed to offer a much greater resistance to shocks. The instructions given out by the Government last year to employ metallic coaches on all express trains are being followed with as much celerity as is possible under the circumstances, and on the Etat, Nord and some other lines most of the fast trains are entirely metallic, although it must obviously take some time to effect completely so important a transformation. The train was an express from Paris to Brest, and it was declared to be running at far beyond the regulation speed when passing over the points as it neared the station of Le Mans in the early hours of the morning. It was heavily laden, and the driver affirms that the brakes failed to reduce the speed sufficiently.

The Saar Dispute.

The miners' strike which was to have been declared in the Saar last week in the event of the Mines Domaniales refusing an advance in wages, has been averted by the intervention of the Government. The men's claims have not been conceded, but Government has given partial satisfaction to the miners by agreeing to pay an unemployment indemnity, and a further inquiry is to be made into the possibility of arranging a new contract with the men whereby it is hoped to safeguard their interests without imposing further charges on the coal mining industry. Trouble is also being threatened in the other coal basins, where an agitation for higher wages is being fostered, but in view of the alleged state of the industry the men are not likely to go to extremes.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

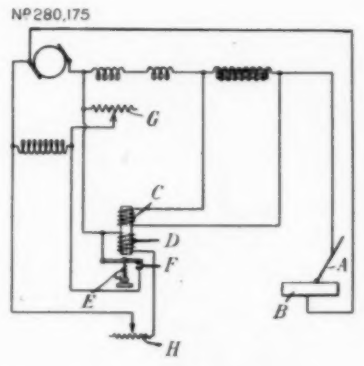
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

DYNAMOS AND MOTORS.

280,175. October 7th, 1927.—IMPROVEMENTS IN OR RELATING TO ELECTRIC WELDING APPARATUS, *Wilson Welder and Metals Company, Inc., of Hoboken, State of New Jersey, United States of America.*

When the arc is broken by moving the electrode A out of engagement with the work B, the current in the welding circuit is interrupted, with consequent cessation of current in the relay winding C, and the current supplied to the relay winding D, under the low-voltage condition of the generator at the time the arc was broken, is not sufficient to maintain the contacts of the relay open against the closing effect of the spring E. The contacts F therefore close and short-circuit the shunt field rheostat G. This short circuiting of the shunt field rheostat causes the voltage of the generator to rise rapidly from its closed circuit voltage of 16 to 18 volts to its normal open circuit voltage,

Nº 280,175



which is assumed to be 35 volts. When the voltage of the generator has risen sufficiently so to energise the relay winding D as to cause the relay contacts to open, the short circuit across the rheostat G is interrupted, thereby making it effective in the shunt field circuit. The generator is now restored to its open circuit condition, under which it delivers 35 volts. In the form of the invention shown a manually adjustable rheostat H arranged in series with the relay winding D, permits adjustment so that the relay contacts will open at any predetermined open-circuit voltage. If desired, the shunt field rheostat G and the relay rheostat H may be so interlocked that one manual adjustment will affect both rheostats, thereby simplifying the control system and insuring rapid recovery of the open circuit voltage of the generator, at any open-circuit voltage for which the field rheostat G may be set.—*July 12th*, 1928.

285,458. April 15th, 1928.—IMPROVEMENTS IN AND RELATING TO DYNAMO-ELECTRIC MACHINE ROTORS, *The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2.*

According to this invention, the laminations of the rotor of an electrical machine are spaced apart by separating rings A and plates B near the periphery. The laminations are provided

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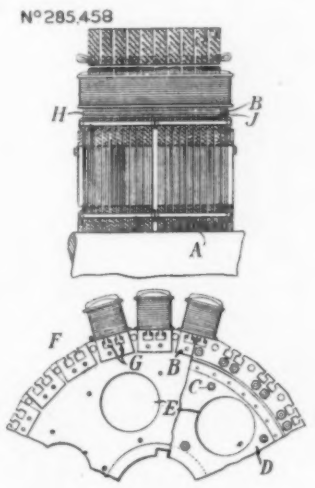
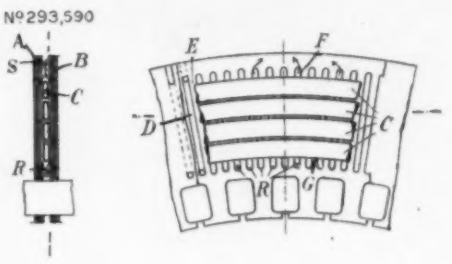


with longitudinal slots for the reception of pole pieces and the peripheral spacing members with slots registering with those in the laminations. Bolts C clamp each section together. A plate D is secured to each section, and is provided with openings E. The grooves F receive shouldered extensions G of the pole pieces. Tapered keys H and J are driven in the grooves F.—*July 12th*, 1928.

293,590. August 22nd, 1927.—IMPROVEMENTS IN OR RELATING TO COOLING ARRANGEMENTS FOR DYNAMO-ELECTRICAL MACHINES, Otto Titusz Bláthy, of 39, Lövöház utca, Budapest, II., Hungary.

The letters A B indicate two neighbouring groups of stator laminations between which water-cooled cooling elements C, consisting, for example, of concentric annular tubes of flattened cross section are arranged. The stator laminations A B adjacent the cooling elements have radial slots D separated by intermediate portions of lamination E, which abut against the cooling elements and provide for the heat conduction between the rest of the stator iron and the cooling elements. The slots D project at both ends beyond the inner and outer limits or edges F and G respectively, of the cooling element. Openings R are thus formed for the entry of the air which flows in the direction of the arrow. The warm air entering by the openings R passes along the passages formed by the slots, is efficiently cooled therein and enters a gap S between the two groups of laminations by the openings, leaving the stator through the gap. It then flows in a cooled condition back to the parts of the machine to be cooled.

Nº 293,590



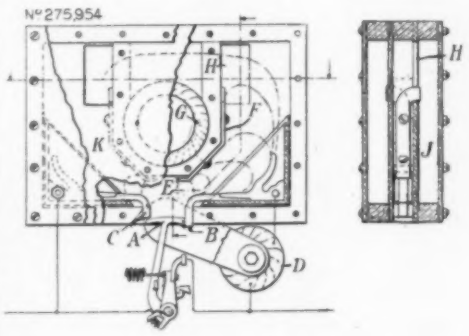
The air passages formed by the slots D are bounded on the one hand by the unslotted laminations of the stator iron and on the other hand by the cooling elements C. Since the groups of laminations are in direct connection through the intermediary of the thin connecting portions or ribs E with the cooling elements, the groups of laminations are well cooled and the air to be cooled thus makes contact with cold walls.—*July 12th*, 1928.

SWITCHGEAR.

275,954. July 25th, 1927.—CIRCUIT BREAKERS, *The British Thomson-Houston Company, Ltd., Crown House, Aldwych, London, W.C. 2.*

This invention relates to arc blow-outs for circuit breakers. The arcing contact of the switch is shown at A, and when the circuit is broken draws out an arc, from the contact B, which is transferred to the contact C. The magnetic coil D drives this arc up into the shoot E, where it bridges across between the

Nº 275,954



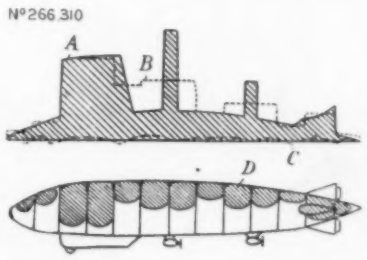
contact B and the metal plate F. It there comes under the influence of the magnetic blow-out coil G, which drives the arc up the shoot, extending it all the time, until it reaches the opening H. The arc then goes from the middle to the outside chamber J and is there further extended by being driven round in a counter clockwise direction. At the same time the left-hand side of the arc is driven round in a clockwise direction round the shoot K and into the opposite compartment.—*July 5th*, 1928.

AERONAUTICS.

266,310. January 27th, 1927.—AIRSHIPS, Luftschiffbau Zeppelin Gesellschaft mit beschränkter Haftung, Friedrichshafen on Bodensee, Germany; and E. Lempertz, of Friedrichshafen on Bodensee.

The inventors propose to propel an airship by means of a fuel gas having the same specific gravity as air. Then, as the voyage progresses, and the fuel is consumed, the aerostatic balance of the machine is not disturbed. They suggest the use of ethylene

Nº 266,310



as having a higher heat value than petrol, weight for weight. The fuel gas is stored in cells below those containing the lifting gas. The diagram shows the curve of loading at A, that of buoyancy at B, and that of bending moment at C. It will be seen that the size of the lifting gas bags D is graduated to suit the local loading, so that bending stresses in the framework are reduced to a minimum. The scheme also has the advantage that, as the fuel has no virtual weight, it does not require any strength in the structure to carry it.—*June 27th*, 1928.

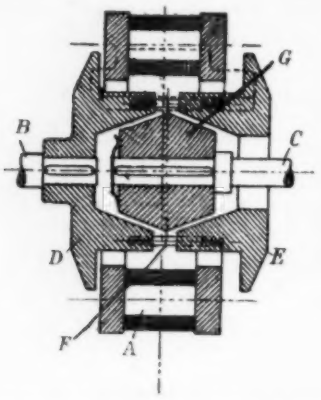
TRANSMISSION OF POWER.

293,277. February 1st, 1928.—MAGNETIC FRICTION CLUTCHES, P. Forster, Viale Casanova 7, Genoa-Cornigliano, Italy.

This clutch is engaged by the energising of the stationary magnet A so as to transmit the drive from the shaft B to the shaft C. On the end of the driving shaft B there is keyed the flange D and this flange carries the second flange E on pegs F in such a way that it may slide axially. On the end of the driven

shaft C there is the double cone G. Springs are provided to keep the parts out of engagement, but when the magnet A is energised

No 293,277



they are pulled together axially and the drive is transmitted from one shaft to the other.—*July 5th*, 1928.

MEASURING AND TESTING INSTRUMENTS.

293,251. November 2nd, 1927.—Depth Gauges, *H. M. Hobson, Ltd.*, 47, *Acton Vale, London, W.* 3.

This invention is concerned with that type of depth gauge in which the depth of liquid in a tank is measured by the hydrostatic pressure, that pressure being transmitted to the gauge through a pipe filled with air. The object is to keep the pipe filled with air automatically. The bell of the gauge, which is

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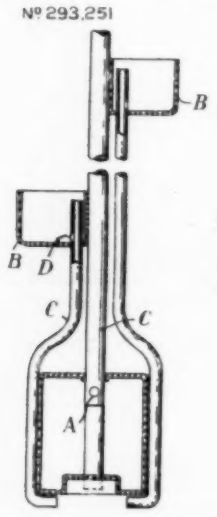
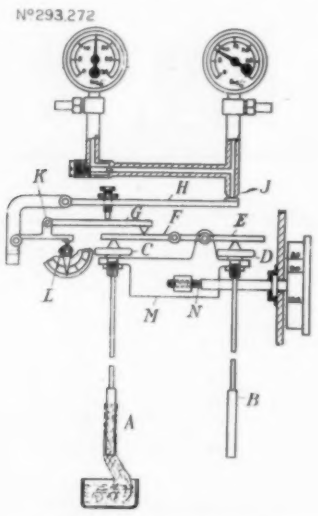


arranged near the bottom of the tank, is shown at A. Higher up in the tank there are open-topped cups B B with pipe connections C C leading down to the open bottom of the bell. These pipes have side ports D within the cups. As the vehicle equipped with the tank travels the petrol within splashes about and fills the cups. This petrol in draining back through the ports D and pipes C entrains air, which is delivered into the gauge bell.—*July 6th*, 1928.

293,272. January 14th, 1928.—Humidity Regulators, B. R. Wingfield and B. T. Wingfield, Brooklyn, West Drayton, Middlesex.

The object of this device is to maintain the relative humidity of an atmosphere regardless of its temperature. It depends for its action on the expansion and contraction of the liquid con-

No 293,272



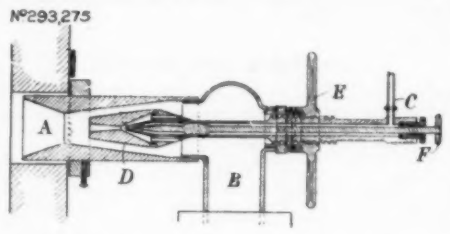
tained in a wet bulb A and a dry bulb B, which operates the diaphragms C and D respectively. These diaphragms operate the two-armed lever E and single-armed levers F, G and H, while H controls the pilot valve J of the humidifying apparatus. It will be seen that the lever G is hinged on a movable pivot K, which can be moved vertically by the hand adjustment L, while the bracket M supporting the lever E can be adjusted horizontally at N. The proportions of the linkwork are such that the desired control of the humidity is effected automatically.—*July 5th*, 1928.

FURNACES.

293,275. August 15th, 1927.—Liquid Fuel Burners, G. Regnac-Paille, 84, Rue de Marcinelle, Charleroi, Belgium.

The distinguishing feature of this oil burner is that the passages for the primary air, which are intended to operate the first atomising of the fuel, are of a constant section opening in the common compressed air inlet duct, whereas the section of the second air passage, through which is conveyed the secondary air

No 293,275



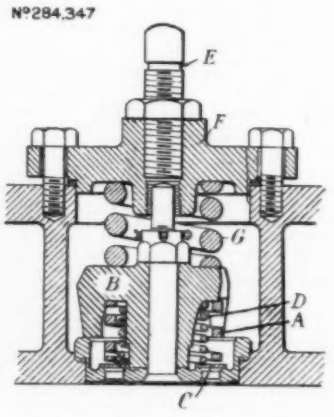
current that is mixed with the liquid fuel, after the latter has been atomised by the primary air, is regulated by means of a hand wheel moving the oil feeding central pipe forward and backward. The burner nozzle is shown at A and the air supply at B. C is the oil supply pipe. The head D can be adjusted, with respect to the nozzle, to control the supply of secondary air, by means of the hand wheel E. The amount of fuel is controlled by the needle valve and thumb screw F.—*July 5th*, 1928.

PUMPING AND BLOWING MACHINERY.

284,347. January 28th, 1928.—Air Compressor Valves, *The Chicago Pneumatic Tool Company, Ltd.*, 6, *East 44th-street, New York.*

The chief peculiarity of this valve lies in the provision of a buffer spring A. This spring is a press fit in the keeper B and

No 284,347



is of such a length that it is normally clear of the valve C. When, however, the valve opens against the resistance of the spring D the spring A brings it gently to rest. The valve assembly is held in place by the set screw E and cover F, and a heavy spring G is provided to hold it down in the event of the set screw slacking off.—*July 5th*, 1928.

TRAMWAYS AND RAILWAYS.

293,221. August 16th, 1927.—Metal Railway Sleepers, E. S. B. Mackenzie-Hughes, 31, rue Robertson, Liége, Belgium.

The object of this invention is to secure the chairs on to a metal sleeper without piercing the sleeper. The sleeper is of inverted trough form as shown in Fig. 1. On its upper face

No 293,221

Fig. 2.

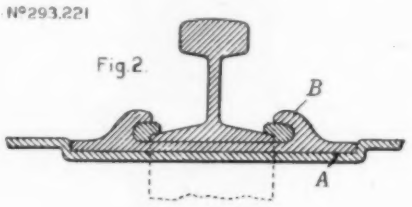


Fig. 1.

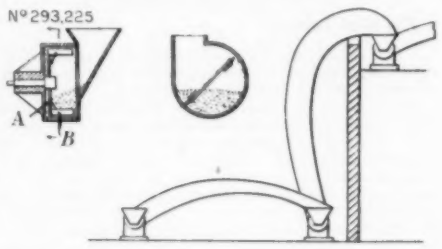
recesses, such as A, are formed for the reception of the chair B, Fig. 2. The chair is formed from rolled strip with lugs to engage the rail as shown. The strip is cut into lengths and punched to cruciform, so that two arms of the cross are shorn of the lugs. These arms are bent, hot, round the sides of the sleeper, as shown at C in Fig. 1, and shrink tight in place. Alternative methods of securing the rail in the chair are described.—*July 5th*, 1928.

MACHINE TOOLS AND SHOP APPLIANCES.

293,225. August 30th, 1927.—Moulding Sand Throwers, F. K. Axmann, 260, Vogelsangerstrasse, Cologne-Ehrenfeld, Germany.

This machine is put forward as a convenient means of transporting moulding sand. It comprises a rotor A driven by any convenient source of power, to which beaters B are hinged. These beaters are held in position by springs. The rotor works in a casing with an axial inlet and a tangential discharge orifice.

No 293,225



The illustrations show an arrangement of two such machines for the horizontal and vertical transport of the sand. It is claimed that not only is the sand conveyed, but it is also thoroughly disintegrated.—*July 5th*, 1928.

293,252. November 5th, 1927.—Grinding Table Knives, J. McClory and Sons, Ltd., Continental Works, Milton-street, Sheffield; and H. F. Atkins, Old Fletton, Peterborough.

This machine is intended to generate the form of the blade of a table knife. The rough blades, one of which is shown at A,

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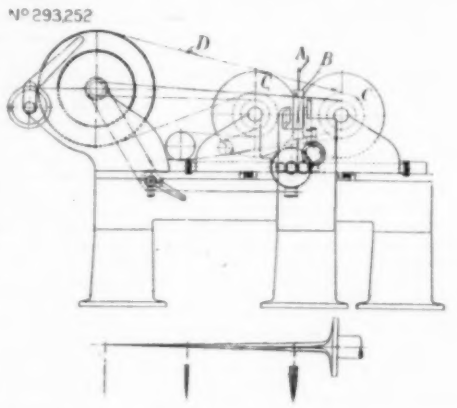

are fixed in a rotary holder B and are passed between the two grinding wheels C C. These wheels are held in headstocks, which are free, within limits, to move on the bed. They are driven by the belt D. Cams are provided to move the headstocks to generate the shape desired and to move the wheels axially to equalise wear.—*July 5th*, 1928.

LAUNCHES AND TRIAL TRIPS.

Poelau Laut, motor cargo vessel; built by Netherland Shipbuilding Company, to the order of Stoomvaart Neatschappij "Nederland;" dimensions, 515ft. 9in. by 61ft. by 36ft. 9in.; displacement, 17,730 tons on a mean draught of 28ft. Engines, Diesel motor to give a speed of 15 knots; constructed by Gebrüder Sulzer A.G., of Winterthur; launch, July 27th.

S.M.P. 5, oil tank steamer; built by De Maas Shipbuilding Company, of Slikkerveer; dimensions, 154ft. by 29ft. 6in. by 13ft.; 730 tons; launch, July 28th.

Rushpool, steamer; built by Cowper Dry Docks and Shipbuilding Company, Ltd., Blyth, to the order of Sir R. Ropner and Co., Ltd., West Hartlepool; dimensions, 435ft. by 54ft. by 29ft. 9in.; 9000 tons deadweight on a draught of 24ft. 9in. Engines, triple-expansion, 26½in., 44in., 73in. by 48in. stroke; constructed by Blair and Co. (1926), Ltd., Stockton-on-Tees; launch, recently.

Juliana, twin-screw steamer; built by the Netherland Shipbuilding Company, Ltd., to the order of Curaçaosche Schepp vaart Maatschappij; dimensions, 305ft. long, 50ft. broad, 15ft. deep; gross tonnage 2587. Engines, two triple-expansion; constructed by Machinefabriek Gebrs. Stork & Company; trial trip, July 29th.

Strabon, steamer; built by Wm. Gray and Co., Ltd., to the order of Compagnie de Navigation d'Orbigny; dimensions, length, 412ft. 6in.; breadth, 53ft.; depth, 27ft. 6in. Engines, triple-expansion, 26in., 43in. and 71in. diameter by 48in. stroke, pressure 180 lb. per square inch; trial trip, July 31st.

Lochmonar, new fore end for the Royal Mail motor vessel Lochmonar; built by Harland and Wolff, Ltd.; dimensions, 175ft. in length; launch, August 2nd.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

Mr. V. Morrison Marshall asks us to announce that he has resigned his position as manager to Light Railways, Ltd., and has joined as a partner the firm of C. M. Hill and Co., engineers, Coventry House, South-place, E.C. 2.

60 B.H.P. Petter Engine.—Petters, Ltd., of Yeovil, ask us to state that the 60 B.H.P. engine exhibited at the Royal Agricultural Society's Show at Nottingham, which was illustrated in Fig. 24 on page 62 of our issue of July 20th and which was described in its title as a paraffin engine, is a fuel oil engine which will run on a wide range of fuel oils.

University College, London, Department of Chemical Engineering.—Mr. J. P. Mullen, M.Eng., has been appointed Lecturer in the Department of Chemical Engineering at University College, London, under the direction of Professor W. E. Gibbs, D.Sc. Mr. Mullen was educated at St. Edward School, Liverpool, and the University of Liverpool. He was Combustion and Production Engineer in the rolling mills and foundries of the Royal Ordnance Factories, Woolwich, and Ballistic Officer, H.M.S. "Excellent," Portsmouth, during the war. Since then he has undertaken research on refrigeration at the University of Illinois, has held the post of development engineer of the Western Electric Company, Chicago, and the post of fuel engineer, Anglo-Persian Oil Company.

SOME RECENT CANADIAN HO-

CHELSEA STATION ON THE GATINEAU RIVER

GREAT FALLS STATION ON THE WINNIPEG RIVER

BARRAGE AND H.T. SWITCHING STRUCTURE—CHELSEA STATION

BRYSON STATION ON THE OTTAWA RIVER